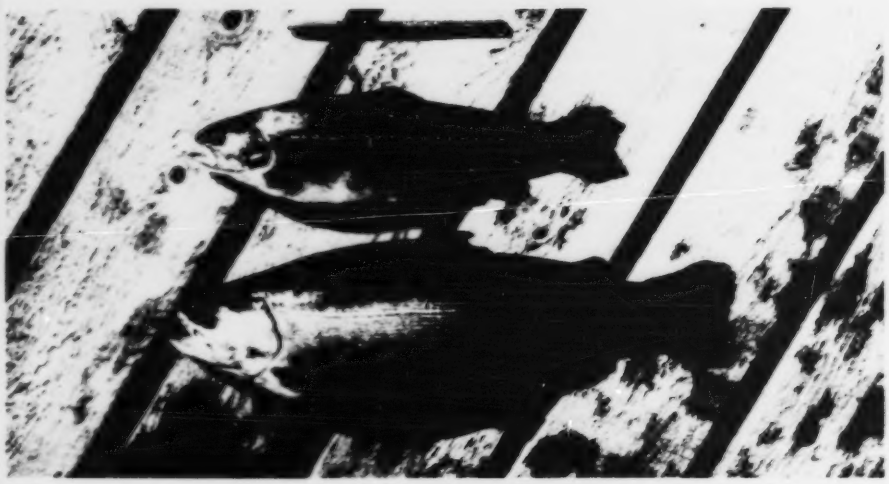
# Aquaculture in Ontario



Ontario

Ministry of Natural Resources

Ministry of Agriculture and Food

Ministry of the Environment

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# AQUACULTURE IN ONTARIO

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## FOREWORD

This booklet was prepared to respond to a growing number of requests for information on aquaculture in Ontario. Most of these requests come to offices of the Ministry of Natural Resources. However, other Ontario government agencies such as the Ministry of Agriculture and Food and the Ministry of the Environment are involved with aquaculture and are asked for information. The booklet describes what aquaculture is in Ontario, gives details of the legislation, licencing and permit system and outlines the approvals process. The booklet is aimed at the first time enquirer and answers basic questions which will help the reader to make an informed decision on whether to follow up an interest in aquaculture in Ontario. It is not a "how-to" explanation of fish culture. References are given for those who want to investigate further.

## ACKNOWLEDGEMENTS

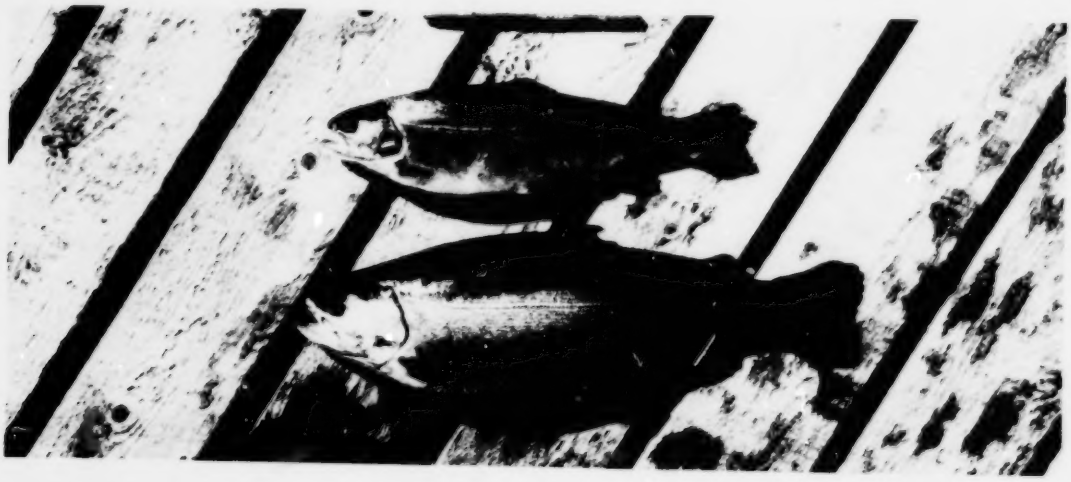
The booklet is a project of the Commercial Aquaculture Liaison Committee (see page 6) to simplify the procedure of passing information to members of the public interested in aquaculture. A number of individuals assisted in the development of the booklet. David Thomson, Economics Branch, OMAF, updated the earlier work on fish farm economics by Herb Blum (also of Economics Branch); Eric Leggatt, Steve Black and George Rocoski, OME, developed the section on pollution potential of fish hatcheries. Work on the booklet was initiated by George Iwama, formerly of Fish Culture Section, Fisheries Branch, OMNR. Allan Castledine, OMNR, completed the task with the assistance of Terry Sowden and other members of Fish Culture Section; critical review was provided throughout by Julian Hynes.

Thanks are due to the secretarial staff of Fish Culture Section - Sue Taylor, Cecilia Potter, Loraine Lavallee and Wendy Greene for their immense patience in finishing the manuscript.

## INTRODUCTION

Aquaculture is the general term used to describe the husbandry of aquatic animals or plants. Commercial aquaculture is the culture of aquatic animals or plants for profit. Fish culture (or fish farming) is the only aquacultural activity practiced in Ontario at present. The predominant species raised is rainbow trout for food fish use and for pond stocking.

Raising fish may, at first glance, seem simple, especially in Ontario which appears to have abundant supplies of water suitable for aquaculture. However, most of the water supplies in Ontario are not ideal, and raising fish can be complicated and, sometimes, unprofitable. Aquaculture does offer opportunities to those who are willing to investigate the business, determine what the constraints may be and develop strategies to overcome them. It must be approached as any business must be; with sufficient research, development of expertise, and financial input. This booklet will point out the environmental, economic and legal aspects of aquaculture in Ontario as well as some potential opportunities.



Rainbow Trout - 99% of cultured fish raised in Ontario for food or stocking (by private producers) is rainbow trout. These fish were raised in net-pens in an experimental project.

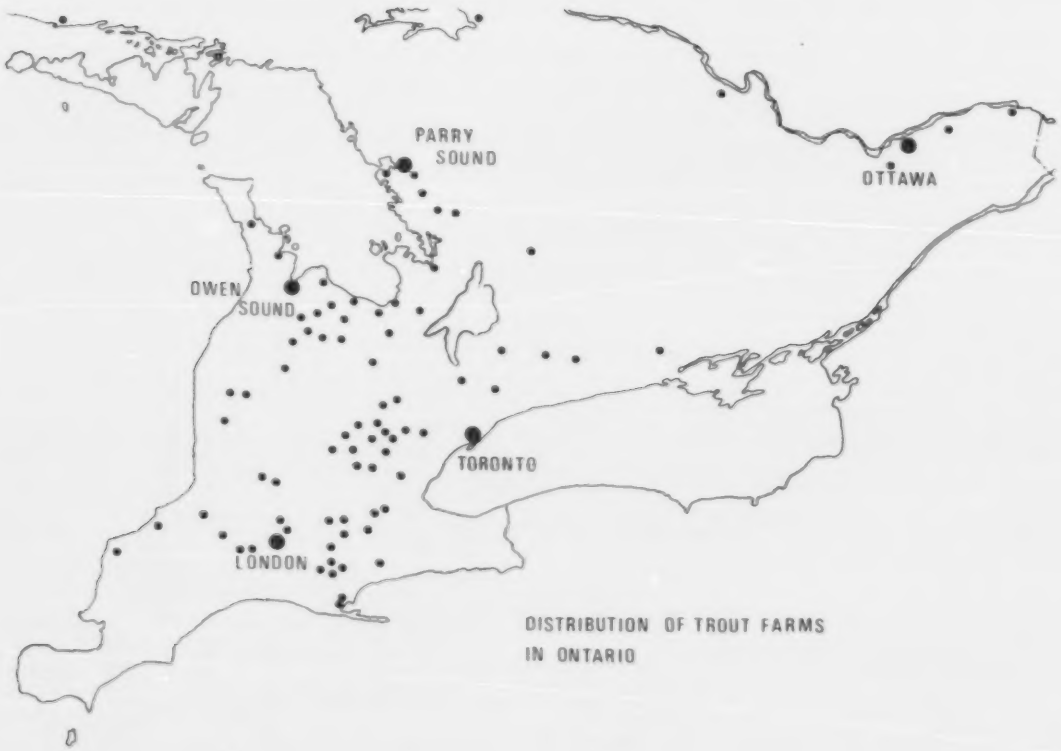
## 1. AQUACULTURAL ACTIVITIES IN ONTARIO

Fish culture has been practiced in Ontario for the past 115 years. Until 1962 it was mostly a government concern with some participation by private hatcheries associated with fishing clubs which produced fish for stocking private ponds. More recently, fish culture has become a commercial activity. Commercial fish farms produce fish for sale to restaurants, fresh-fish stores, supermarkets, other fish farms, to owners of private ponds for stocking and to operators of fee-fishing ponds. Some fish are also sold to the Ontario Ministry of Natural Resources (OMNR) to supplement its requirements for stocking Provincial Fishing Areas and natural waters. The total value of sales by commercial producers was approximately $4 million in 1984.

The production and sale of trout for human consumption was first permitted in Ontario in 1962. Since then, the number of fish farms has increased steadily - from 16, to 115. The industry employs at least 125 persons; 60 on a full time basis. The annual production of fish (mostly rainbow trout) increased ten-fold between 1972 and 1982 to 540 tonnes (1.2 million pounds). Estimates of 1985 production are approximately 700 tonnes. This is about one half of the total amount of rainbow trout sold in Ontario annually. Most of the rest is imported ,frozen, from the U.S. state of Idaho where a large trout farming industry has been established due to the existence of abundant supplies of high-quality spring water. In general, trout farmers in Ontario do not compete in the frozen-fish market, but sell most of their fish fresh, receiving a higher price than do the Idaho exporters. Replacing all of the Idaho imports with domestically grown fish on a competitive basis is an important challenge facing Ontario trout farmers. Smoked trout is increasing in popularity and several Ontario producers sell this product.

An additional aquacultural activity is the operation of Fishing Preserves ("fish-out" or "fee-fishing" ponds). These are often located on licenced fish farms. Ponds are stocked with fish and members of the public pay a fee for the fish they catch. There are about forty such operations in the province.

A lack of the high-quality water sources necessary for trout production is a major factor limiting the growth of fish farming in Ontario. Most of the fresh water in Ontario is surface water (lakes, rivers, etc.), which is not desirable for rearing fish. Surface waters have seasonal fluctuations in water quality characteristics such as temperature (too hot in summer, too cold in winter) and dissolved oxygen (necessary for sustaining fish life) which usually make them poor choices for fish culture. Surface waters also have the potential for disease transmission to and from wild fish living in those waters. Groundwater (springs and wells) which is much safer for fish culture is in much shorter supply. Most fish farms in Ontario are located in south-central and southwestern Ontario, with many located along the Niagara escarpment where fairly large volumes of good quality groundwater have been found. (The significance of water quality and quantity are discussed further in another section of this booklet.)




DISTRIBUTION OF TROUT FARMS IN ONTARIO

It may be possible to increase production from existing sites and to make poor quality water more productive by using new technology. For example, water may be used several times through the use of biological and mechanical filters. Water re-use is used on some Ontario fish farms. Several studies have been carried out on the feasibility of using heated waters from generating stations and using industrial waste heat for aquaculture. These operations would be complex, and costly to start. However such projects may be essential to continued growth of aquaculture in Ontario.

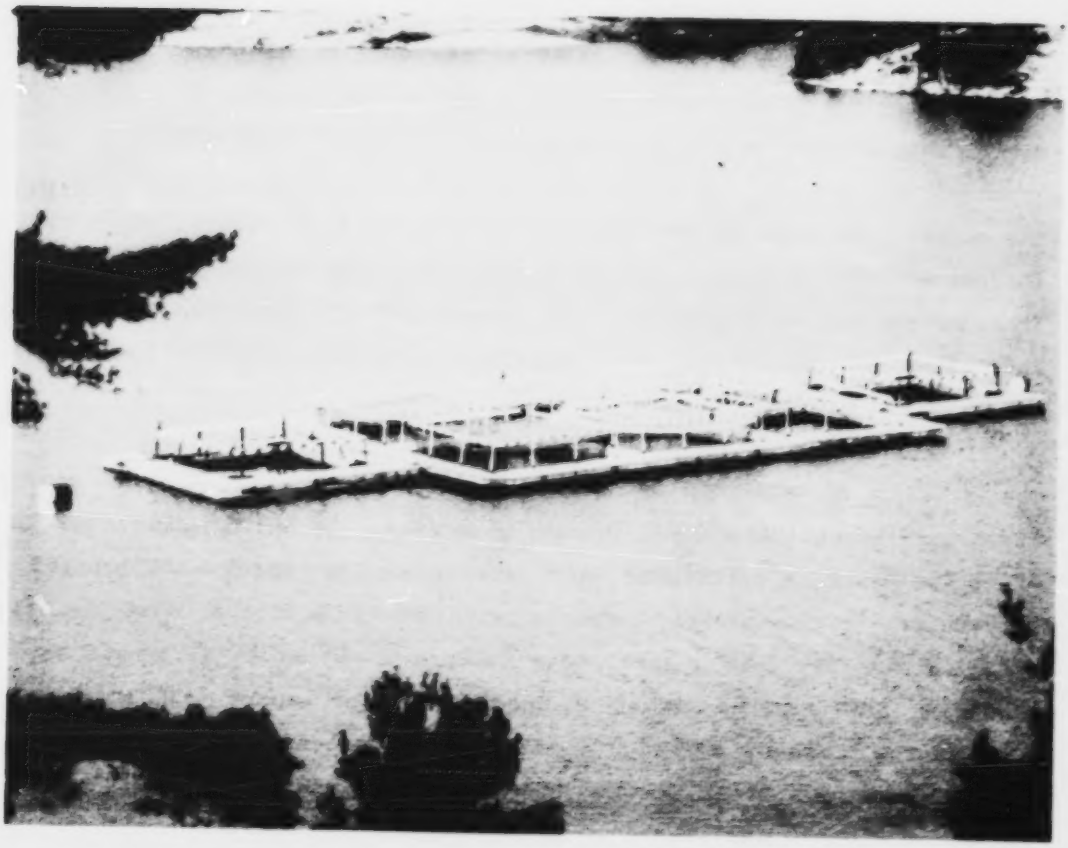
A recent idea which has allowed greatly increased production from a conventional fish farm is the use of liquid oxygen to maintain high oxygen concentrations in the water. By using liquid oxygen, 3 or more times as many fish may be reared in a given amount of water. The use of liquid oxygen is not without its problems. Demanding management is required because of the increased fish concentrations and the resulting decrease in water quality (e.g. increased ammonia, see discussion of water requirements on page 9). In addition, the quality of water leaving the facility may not comply with standards set by the Ontario Ministry of the Environment without suitable (and perhaps expensive) treatment.

The culture and sale of baitfish may be a profitable aquaculture activity in future. The present baitfish industry depends on the capture of wild fish to satisfy its markets. As stocks of wild baitfish become less available and as demand for baitfish increases, production through aquaculture will become more attractive.

The rearing of fish in net-pens or cages suspended in the sea or freshwater lakes takes place in many countries. Depending upon other uses of the water at a particular site (recreation, navigation, etc.) and in particular, environmental concerns with waste products from the fish entering directly into a lake, cage culture could be an alternate way of producing fish for the market in Ontario, or for export. In addition to some of the problems outlined above, other concerns such as transfer of disease from wild fish to the cultured fish (and vice-versa) and high summer surface water temperatures must be considered. Year-round operation may be impractical in Ontario because of ice conditions. This will result in a seasonal production cycle with large numbers of fish

entering the market in the Fall, perhaps depressing prices. Despite these drawbacks there is a potential for some cage culture in Ontario.

From time to time, we are asked if it would be possible to grow species such as shrimp, lobsters, warm water and/or saltwater fish species in Ontario. The obvious attraction is that there is a good demand for some of these products and they would sell for a high price. While it is possible to raise these animals in Ontario, the cost and difficulty of providing them with a suitable environment (suitable temperatures, salt water, etc.) - and proper feeds, would be so great that production expenses would likely far exceed returns from sales. The same analysis is true for such native species as crayfish at the present time. Major technological advances are required before such ventures should be considered.



Experimental cage (or net-pen) culture near Swift Current, Manitoulin Island, Lake Huron.

## 3. INVOLVEMENT OF GOVERNMENT AND PRIVATE AGENCIES IN COMMERCIAL AQUACULTURE

Commercial aquaculture in Ontario has two main activities; the culture and sale of fish, and the operation of fishing preserves. These activities produce food, provide recreation, and use water. Various government agencies have interests in one or more of these aspects of the industry through promotional, regulatory, developmental, and advisory roles.

### Ontario Ministry of Natural Resources (OMNR)

One function of the OMNR is managing the fisheries of this province. Consequently, OMNR administers many of the regulations that control the use of water and hence, aquaculture in Ontario. The OMNR issues the licences and permits which allow the culture and sale of fish and the transfer of fish from one body of water in Ontario to another (see Section 5). The licencing and permit system is required in order to prevent the possible spread of harmful fish species and diseases. In addition to this regulatory role, OMNR supports research and development (R&D) programs in fish nutrition, genetics, and health which benefit the industry. The Ministry also provides some technical advice to prospective and practicing fish farmers through the staff of Fish Culture Section, district offices, and fish culture stations. OMNR has also given some financial support to aquaculture development in the province. For example, the Ontario Trout Farmers Association (OTFA) has received grants to cover incidental expenses in various projects. In addition, the Ministry has sponsored or directed several studies of the industry.

### Ontario Ministry of Agriculture and Food (OMAF)

OMAF recognizes the commercial aquaculture industry as a farming activity which produces food. Therefore, those beginning an operation or engaged in fish farming may be eligible for support under a variety of OMAF farm productivity programs. OMAF has sponsored R&D programs in fish health, genetics and nutrition and granted funds to the OTFA for incidental

expenses in various promotional and research projects. In addition, OMAF conducted an economic study of the fish farming industry in 1979, and since 1980 has provided partial support for a fish disease diagnostic service for fish farmers through the Department of Pathology at the Ontario Veterinary College, Guelph.

**Ontario Ministry of the Environment (OME)**

OME has noted the increasing number of fish farms in Ontario and is concerned about the pollution potential of hatchery effluents on receiving waters. OME requires that the 'Permit to Take Water' and a 'Certificate of Approval' be obtained by all proponents before they start a fish farm or make any modifications to existing operations (see section 6).

OME has other involvements in fish farming such as i) funding for studies in the manipulation of waste loadings by modifying diets, ii) providing monitoring and analysis of water quality, and iii) providing technical expertise on water quality and waste effluent characteristics to fish farmers.

**Canada Department of Fisheries and Oceans (DFO)**

The Aquaculture and Resource Development Branch of DFO has provided services to the industry through the distribution of technical information, participation in seminars and provision of fish health inspections under the Fish Health Certification Program. DFO funded fish nutrition research at the University of Guelph from 1973-1978. DFO also supports various internal R&D programs of its own, some of which have direct relevance to Ontario aquaculture. In addition, DFO has supported several aquaculture developmental projects in the province.

**Commercial Aquaculture Liaison Committee**

A committee with representatives from the above organizations and private fish farmers has been established in order to coordinate R&D efforts and services from government to the industry. The committee is a forum for sharing expertise so that legislation, regulations, policies and programs

appropriate to this industry can be formulated within each agency. The present chairman of the committee is the Supervisor, Fish Culture Section, OMNR, Queen's Park, Toronto.

## NON-GOVERNMENT ASSOCIATIONS

### Ontario Trout Farmers Association (OTFA)

The OTFA was formed in 1975 to unify the industry, promote its products, organize cooperative buying, disseminate information and represent the industry in dealing with government. In 1984, 60% of licenced fish farmers were OTFA members. The OTFA sponsors promotional activities, technical meetings and an annual convention and trade show. It also publishes a trade magazine - Ontario Trout.

The address of the Ontario Trout Farmers' Association is:

P.O. Box 1633
Guelph, Ontario
N1H 6R7

### The Ontario Trout Producers' Cooperative Ltd.

The Cooperative was formed in 1982 to provide members with a central processing and distribution centre and to combine production from a number of fish farms to provide a consistent large-volume supply of fish. The Cooperative's head-quarters is in Guelph and the processing facility is located on the grounds of the Guelph Correctional Centre. More information on the Cooperative may be obtained by writing to:

The Manager
Ontario Trout Producers' Cooperative
Box 1748
Guelph, Ontario
N1H 6Z9

## 3. INTRODUCTION TO THE FUNDAMENTALS OF FISH CULTURE

This section presents some basic concepts of fish culture - a detailed review is not intended. The reader should refer to one or more references (see appendix 6) for this information.

**Species**

Virtually all of the fish grown commercially in Ontario are rainbow trout and brook trout. Ninety-five per-cent of production is rainbow trout, which is marketed primarily as food fish. Brook trout are generally raised for stocking. Although the culture and sale of bass for stocking has been permitted for over 20 years, their culture is very limited at present.

There are several reasons why commercial aquaculture has centred on the production of trout.

1) Culture techniques for these species are well known, following over 100 years of hatchery propagation and government research in culture of these fish.

2) Some species have become domesticated and can be easily raised in confinement.

3) Their nutritional requirements have been intensively investigated resulting in the availability of good quality commercial feeds.

4) Water temperatures in Ontario are suitable for their culture.

5) These species are widespread naturally in Ontario and consequently their culture results in minimal risk of interference with natural fish communities if they escape from culture facilities.

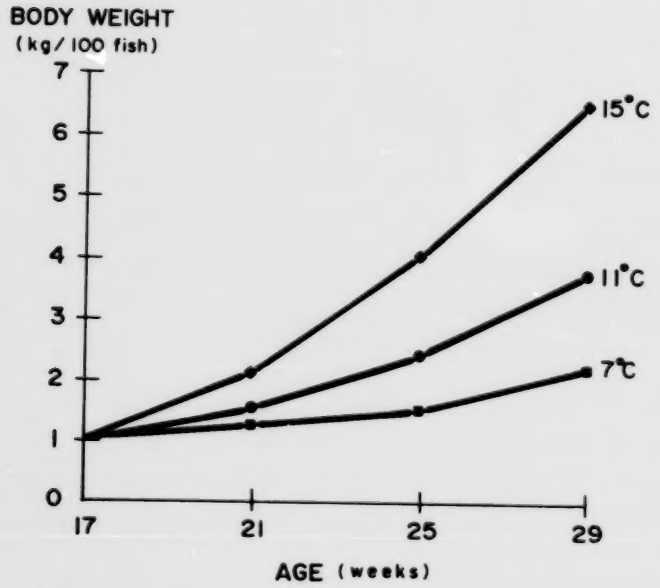
6) There is a recognized demand for this product for human consumption and stocking.

The following discussions of water requirements, site selection considerations, and rearing units apply largely to the culture of trout species. However, the culture of any species will require the same type of analysis.

**Water Requirements**

The availability of sufficient volumes of high-quality water is the most important factor for successful fish farming. The growth and survival of fish is directly dependent on the quality of the water in which they are reared. Table 1 summarizes guidelines for water quality suitable for the culture of rainbow trout and brook trout.

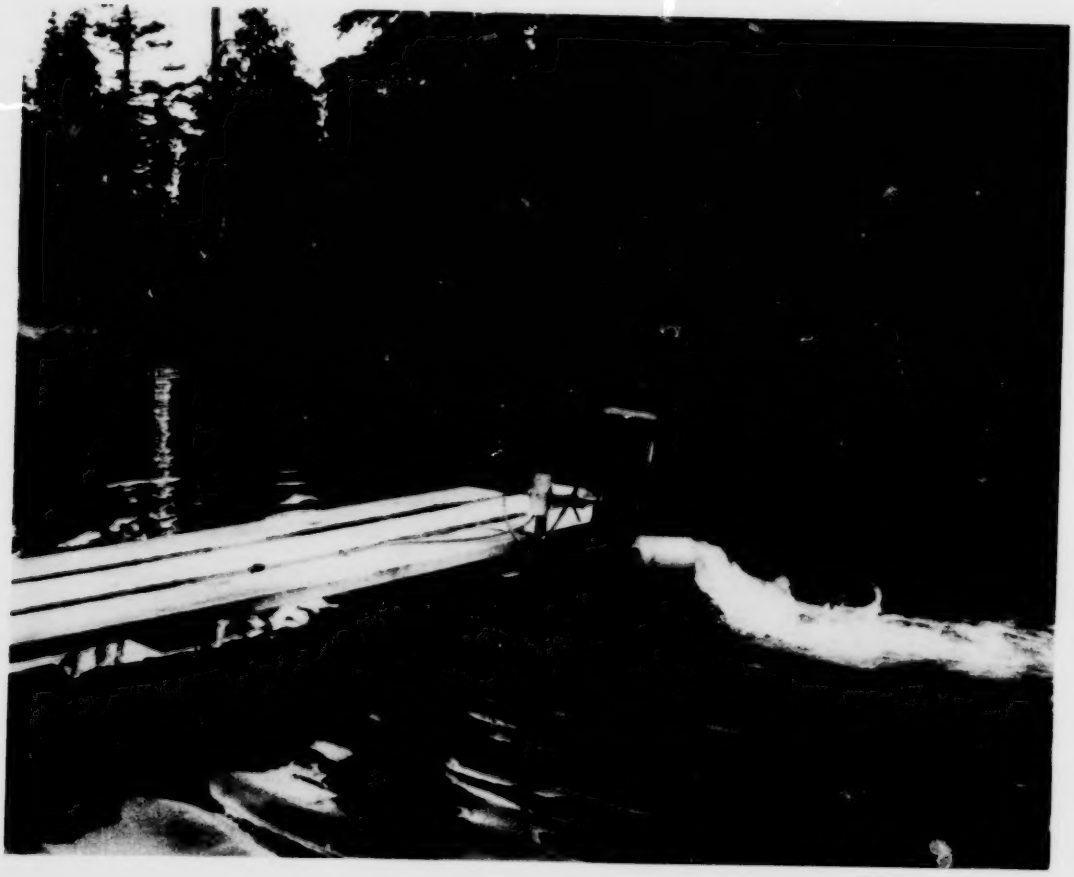
Given good water quality, the greatest influence on fish growth is water temperature. The diagram below illustrates that as water temperatures increase from 7°C to 15°C, growth rate increases. Trout are cold-blooded animals, and their metabolic rate depends on the temperature of their environment. Thus at low water temperatures, slow metabolism limits their growth. At high water temperatures, thermal stress disturbs the normal metabolism of fish and less energy is channelled into growth. Dissolved




RAINBOW TROUT GROWTH AT THREE WATER TEMPERATURES

oxygen levels decrease as temperatures increase and this may also contribute to limiting growth. At 15°C a balance is achieved between metabolic rate and oxygen availability which results in optimum growth of trout. Growth rate may remain high up to about 20° C. However, feed efficiency will decrease.

Some of the water quality characteristics described in Table 1 can be altered. For example, oxygen levels may be increased and nitrogen levels decreased simply through mechanical agitation of the water supply by allowing the water to splash over a series of baffles before entering the rearing facilities. Other characteristics, for example high levels of hydrogen sulphide, may not be suitably reduced to allow successful fish culture.



Use of a mechanical aerator to raise oxygen levels in a stocked pond. Aerators such as this can also be used in intensive culture in raceways, circular tanks or ponds, to increase production by providing a greater supply of oxygen to the fish.

Table I Water Quality Characteristics of Significance in Trout Farming

| Parameter | Range or Level | Comment |
|---|---|---|
| Temperature | Optimum 15°C<br>For growth 5-20°C<br>Lower lethal -1°C<br>Upper lethal = 25°C | The most significant factor in controlling fish growth. For rainbow trout, growth is slower or less efficient at temperatures above and below 15°C*. At 8°C growth is half that at 15°C. Dissolved oxygen levels are affected by temperature. As the temperature increases the oxygen concentration decreases.<br>*Similarly, other fish species will grow over a range of temperatures but will also have an optimum. |
| Dissolved Oxygen (D.O.) | Greater than 5.0 mg/L (ppm) | At no location in the fish-rearing facility and at no time, should the D.O. fall below 5 mg/l. Water entering the facility should be as close to saturation as possible. Increasing altitude and temperatures reduce the oxygen carrying capacity of water. |
| Dissolved Nitrogen | Less than 102% of Saturation | Groundwater (water taken from the head of springs, artesian wells or pumped from underground) is often deficient in oxygen and supersaturated with nitrogen. Fish held in water supersaturated with nitrogen may develop gas-bubble disease as nitrogen gas is released from the blood. Young fish are particularly susceptible to the effects of dissolved nitrogen. |
| pH (acidity) | Recommended 7.5-8.0<br>Suitable 6.7-8.6 | Low pH increases susceptibility to disease - probably by decreasing the ability of mucous to protect the fish. pH affects the balance between harmful and harmless forms of ammonia. (See information on ammonia which follows.) |

Table I Water Quality Characteristics of Significance in Trout Farming (cont'd)

| Parameter | Range or Level | Comment |
|---|---|---|
| Ammonia | Less than 0.012 mg/L (ppm) $NH_3$ | Some natural water sources may have unacceptably high levels of ammonia. Ammonia is also a major by-product of metabolism in fish. Ammonia exists in two forms, $NH_3$ and $NH_4^+$, dependent on pH. The un-ionized form, $NH_3$, which is toxic becomes more prevalent at higher pH. Ammonia levels in facilities are dependent on fish density and rate of metabolism (affected by D.O., feeding rate, temperature, etc.). |
| Alkalinity (hardness generally associated with levels of dissolved calcium carbonate) | 20-200 mg/L (ppm) | Soft and hard water refer to alkalinities of less and more than 100 mg./ l. respectively. Low alkalinity results in "failure to thrive" - slow growth and poor condition. |
| Suspended Solids | less than 80 mg/L (ppm) | Sufficient suspended solids to make water slightly cloudy may clog gill tissues decreasing growth rates and increasing susceptibility to bacterial gill disease. |
| Hydrogen Sulfide | less than 0.002 mg/L (ppm) | This gas is often present in artesian waters and is detrimental to fish production. |
| Iron | less than 1.0 mg/L (ppm) (0.3 ppm for hatching eggs or small fish) | Various dissolved minerals including iron may be present at levels which would make the water unsuitable for fish farming. |

The quantity of water (volume per unit time) available at a site will limit the number (total weight) of fish that can potentially be produced. This is because water quality in rearing units deteriorates as fish use up the dissolved oxygen and excrete waste products. This deterioration increases with the time required for inflowing water to completely replace the volume of water contained in a rearing unit (replacement time). Low inflows mean longer water exchange times. Water-quality deterioration is also dependent on the number (or weight) of fish in a unit (loading) so that where water exchange times are long, a reduction in loading may be necessary to ensure that the growth and survival of fish are not impaired. In this way, the quantity of water available at a site may limit production capability and thus affect the economic viability of a proposed facility. It is therefore crucial to determine the supply of water available at a site before commitments are made to develop it.

On average, Ontario trout farms produce 4 kg of trout per year per litre per minute of water (Lpm) (35 lbs. of trout per year per gallon per minute (gpm) of water supply). Production may be pushed up to 12 kg/Lpm (100 lbs/gpm) and more through water treatment and re-use, and careful production planning. However, risks of fish loss through stress increase under these high density conditions, and additional measures must be taken to maintain adequate water quality.

**Site Selection Considerations**

The suitability of a site for establishing a commercial fish-rearing facility is dependent on several factors. These are reviewed below. All should be carefully investigated since each may have a significant impact on the viability of a proposed fish farm.

1. Water Supply

i) Source:

Water supplies suitable for fish farms include; springs and artesian wells (free-flowing groundwater), groundwater pumped from aquifers,

and surface water diverted from natural water courses. Groundwater is superior to surface water as a supply, particularly for salmonids, because temperatures are relatively uniform year-round and this water is generally free of pollutants, including occasional spills that sometimes occur in surface waters, and disease agents. Springs or artesian wells are the preferred source of groundwater since no effort or expense is required to pump water out of the ground. Despite these advantages, the temperature of groundwater in Ontario is too low for optimum trout growth.

Fish farms in Ontario operate on all of the above water sources. In some cases only one source is used, while in others, two, or all three sources, are used in combination.

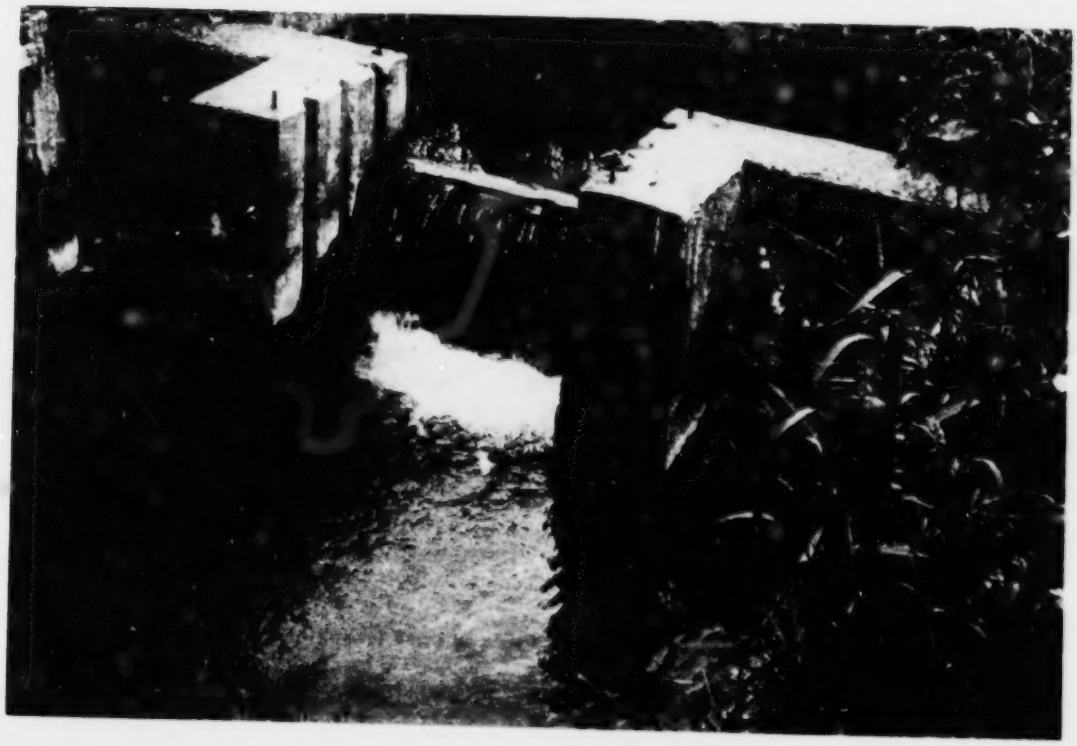
ii) Water Quantity Requirements:

A 1977 survey of Ontario trout farms indicated that the amount of water used ranged from 40 Lpm (8 gpm) to 30,000 Lpm (7000 gpm). Fifty-five per cent of the facilities used less than 1100 Lpm (250 gpm), 29% used between 1,100 Lpm (250 gpm) and 4,500 Lpm (1000 gpm), and the remaining 16% used over 4500 Lpm (1000 gpm). These percentages indicate the low availability in Ontario of sites with large volumes of spring water. The highest volume noted above - 30,000 Lpm - is derived mostly from a surface water source.

The foregoing discussions have stressed the importance of knowing the supply of water available at a site. The following information provides suggestions on how to determine the supply of water potentially available at a proposed site.

The discharge of groundwater from springs can be relatively stable or quite variable, depending upon the nature of the aquifer (underground water source) supplying the spring. Springs draining shallow aquifers may show great seasonal fluctuations in discharge. "Deep-seated" springs draining ground-water from deep aquifers, and springs and wells receiving ground-water under artesian pressure may have very stable flows throughout the year.

It is important to determine seasonal variations in flow over at least a one year period, especially the magnitude and duration of low flows (late summer-fall-winter) which will limit the potential production capacity of a site. Flow determinations made on a weekly basis are adequate to obtain a good idea of seasonal variations in flow from a spring. Reasonably accurate measurements of volume of flow can be made as described in Appendix 7.



A water-control structure on a small spring source. Exposure of the water to air as it cascades over the weir increases its oxygen content. This type of structure allows simple measurement of volume of water flow - see Appendix 7. Temporary structures can also be built to make an accurate determination of water available. This particular flow is approximately 675 litres (150 gallons) per minute.

The availability of groundwater from drilled wells is also dependent on the nature of the aquifer being tapped. Precise determination of groundwater availability at specific sites would require drilling test wells, and having pump tests conducted. However a rough idea of groundwater availability in most areas can be obtained from water-well records compiled by the OME. Individual well records are available and this information has also been compiled into groundwater availability maps which indicate the approximate quantity of groundwater available from different types of aquifer. In addition, OME has conducted detailed investigations of groundwater resources for certain selected watersheds in southern Ontario. If pumped groundwater is planned as a major water supply, a hydrogeologist should be consulted to confirm availability at a specific site.

If diversion of water from a flowing natural water course is considered, application must be made to the OMNR District Office and the OME Regional Office. OMNR Districts may restrict the amount of water that can be withdrawn or diverted, in order to protect native fish populations. This restriction may be either total (no diversion allowed), or set as a percentage of the stream's lowest discharge during the year. Therefore, in exploring the possibility of using a natural water course as a supply, OMNR and the OME Regional Office must be consulted first to establish if water can be diverted. Temperature, turbidity, contaminants and fish disease agents are other very real concerns in determining the suitability of a natural water course as a water supply.

iii) Water Quality Requirements:

The characteristics of a water supply must be suited to the requirements of the fish species which will be raised. When water quality is poor, fish become stressed, fail to grow and may die. Therefore potential water supplies should be tested to determine their suitability for culturing fish. For rearing trout, water supplies should meet the requirements outlined in Table 1. Water samples can be submitted to commercial laboratories for analysis.

Temperature is one of the most important factors governing the suitability of a water supply. The cost of artificially heating or cooling the volumes of water needed to operate a facility, even by a few degrees, is prohibitive (the use of solar radiation may represent an exception). Therefore, water temperatures should be monitored over a one year period to determine if they are suitable. Since water temperature must remain around 15°C for optimum growth of trout, the importance of knowing the seasonal fluctuations in water temperature is clear. Capital costs aside, solar heating is probably the only practical means of heating water which is too cool for optimum growth of fish and this may only be practical for rearing small fish for a short period of time. If water temperatures exceed about 20°C, thermal stress and reduced solubility of oxygen will seriously impair fish growth and survival.

Groundwater temperatures are usually cold (5-10°C) and uniform year round. However, groundwater is often deficient in dissolved oxygen and high in other harmful gases such as nitrogen. Aeration can reverse this situation and return dissolved gases to levels suitable for fish culture.

Land use in the vicinity of a proposed fish-farm site can degrade the quality of surface and groundwater supplies. Agricultural, industrial and residential developments may pollute water supplies with pesticides, heavy metals, nitrates and other contaminants. In areas where such pollution seems possible, water samples should be submitted for analysis to be screened for these contaminants. In addition, possible future land use in the vicinity should be investigated to determine what the long term effect on water supply may be. The possibility of periodic accidental releases of contaminants such as spills of substances being transported, run-off from agricultural operations (pesticides, leachate from manure piles, etc.) should be assessed.

2. Elevations:

The elevations on a property will have a significant effect on facility design which will in turn affect capital and operating costs and potential production. An ideal site would be one in which no pumping or mechanical aeration of water would be required. That is, water would be moved to the facility, through the rearing units, and even aerated between uses by using natural elevations ("drops"or "head") on the property. Enough hydraulic head and room must be left to locate treatment facilities on the lower end of the property and to operate them effectively. The use of gravity in this way avoids the costs associated with pumping water (reducing the costs of production) and eliminates the potential for large fish mortalities (due to oxygen depletion resulting from pump failure).

3. Other

Costs of site servicing (access roads, power lines) and distance to markets are important considerations. Transportation costs; incoming (eg. feed delivery) and outgoing (fish to market) can be a significant drain on earning capability.

Soils in the area on which the facility is to be built should be tested to determine whether they can support the type of facility planned. Often, marshy low-lying areas, are not suited for building conventional in-ground raceways and some other rearing-unit must be considered.

**Rearing Units**

Rearing unit refers to a "container" in which fish are held during the rearing process, (e.g., ponds, raceways, circular tanks, etc.)

i) Natural Ponds

Small, natural ponds may be used to raise fish. Depending on size and shape of ponds and the stocking density of fish, such ponds may support sufficient natural production without supplemental feeding

to provide recreation and food for a family or small group of recreational anglers. However, natural ponds, or man-made ponds designed primarily for recreation, are generally not suitable for commercial-scale fish production. Disadvantages are: the inability to increase production in any substantial way by supplemental feeding due to low water turnover and the resulting accumulation and degradation of waste products and unused feed; the potential for disease due to inadequate flushing; fluctuations in temperature; difficulty in harvesting because of the size and irregular configuration of the pond, aquatic vegetation; the lack of uniformity in size of fish produced; fish often cannot be over-wintered because of ice-cover and potential for winter-kill. (This problem may be overcome through aeration.)

A stocked pond on a Fishing Preserve.

ii) Earthen Fish Ponds

Ponds may be constructed specifically for rearing fish. They are designed to be managed more effectively than those described above. Dimensions may vary. However, a length of 25 metres (80 feet) and a width of 12 metres (40') with an average depth of 1.5 metres (5') is

typical. The ponds are designed to enable total drainage in order to ensure complete harvest of the fish and allow periodic cleaning. Water flows in such ponds are relatively high and a turnover occurs approximately every 12-24 hours. Often, the water is agitated mechanically or air is bubbled through by means of compressors to raise or maintain oxygen levels.

Earthen fish ponds may be inexpensive and easy to construct. However, they have many of the same disadvantages listed for "natural ponds" above.

An example of earthen (unlined) ponds dug into an underlying gravel layer in an area which has a high water table.

iii) Raceways

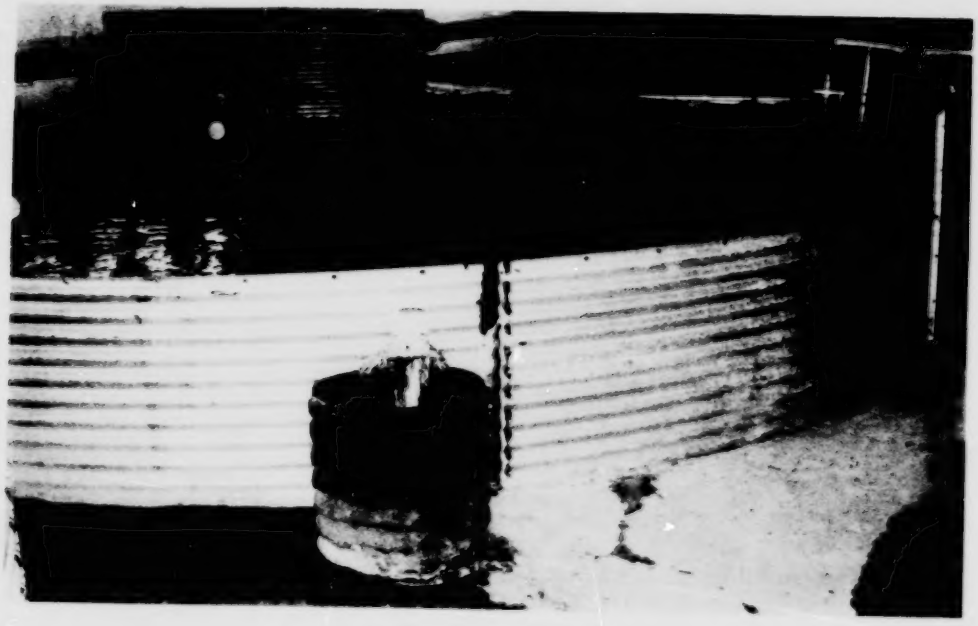
More typical of present trout culture practices in Ontario is the use of raceways. Raceways are relatively large, rectangular rearing units. Dimensions vary but are generally 15-25 metres (50 to 80 feet) in length, 2-3 metres (6-10 feet) in width and 0.5-1.0 metres (1 1/2 to 3 feet) in depth. Water flows quite rapidly through raceways, entering at one end and exiting at the other. In

raceways, a complete water exchange should take place at least once every 60 minutes. Raceways may be set up in series with several units using the same water. It is advisable to introduce some fresh water at the head of each succeeding raceway. The carrying capacity (see following) of the units decreases as the water is re-used. Raceways may be constructed of a variety of materials and placed in, or on, the ground. Concrete is often used, however raceways may also be prefabricated of sheet metal and covered with a vinyl liner. Raceways have the advantage of allowing several groups of fish to be held in one unit by the use of screens. Fish may also be concentrated in this way to allow grading and treatment for disease. The water level in raceways is easily manipulated and fish can be removed from the units very efficiently. A disadvantage of raceways is that the fish tend to congregate at the top end where incoming water provides maximum oxygen levels and current. Therefore, the total volume of the raceway is not fully utilized.

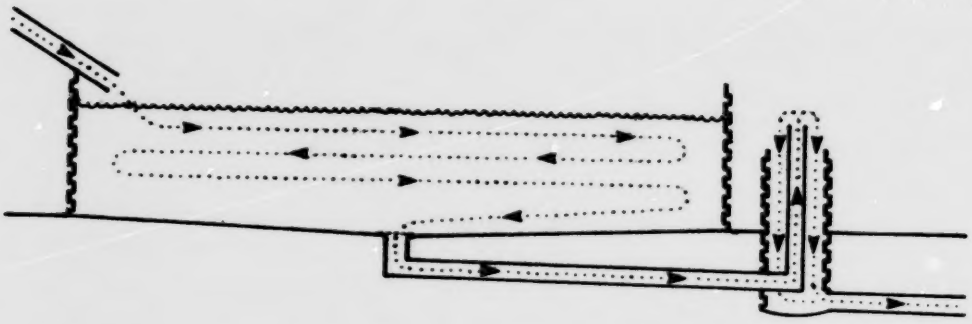
An example of raceways on a large Ontario trout farm. Note the use of demand feeders. String is used over the raceways to discourage fish-eating birds.

iv) Circular Tanks

Circular tanks or ponds may be placed inground or above ground and be fabricated in several ways. Poured concrete, concrete blocks, galvanized steel lined with polyvinyl (swimming pool liners) and fibreglass have all been used. There is also a common design using silo walls and a concrete floor. These units are generally from 2 to 7 metres (6 to 25 feet) in diameter and 0.5 to 0.8 metres (1.5 to 2.5 feet) in depth, sloping to a central drain. Water is introduced in a manner that sets up a counter-clockwise circular flow. Because of this, circular tanks usually require less water per unit of fish reared than raceways as the rotating water flow maintains relatively homogeneous water quality and the fish distribute themselves more evenly throughout the tank, utilizing the rearing space more effectively. Fin condition of fish reared in circulars is often better than that of fish raised in raceways. Circular tanks are more-or-less self-cleaning as waste materials collect at the central drain.



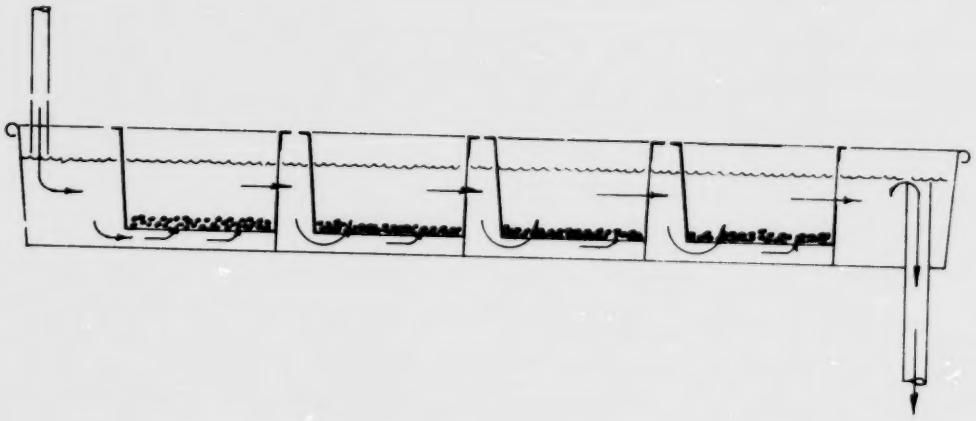
A common type of circular tank found on many trout farms. Note the water level control structure in the foreground and the small demand feeder attached to the tank.



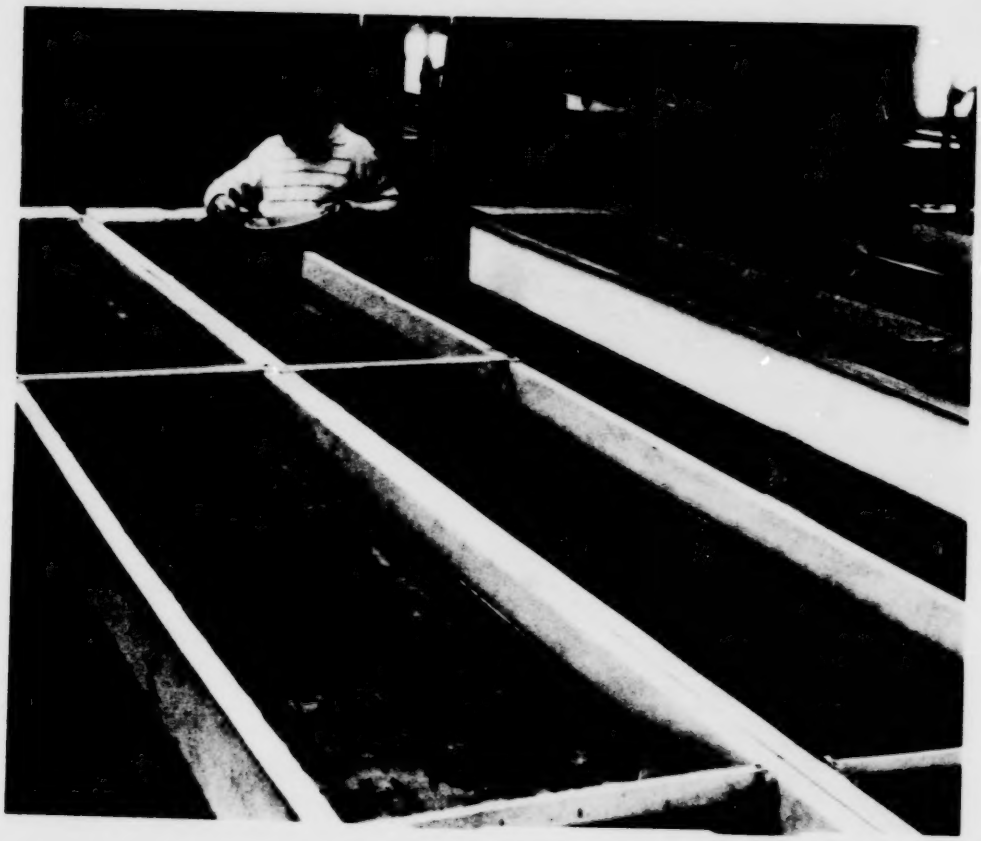
Schematic diagram of a circular tank showing the water level control structure and water flow pattern. Depth can be controlled by using standpipes of different heights.

v) Troughs

Troughs are miniature raceways used to hold very small or newly-hatched fish prior to their introduction to the larger rearing units. They are commonly 3-4 m (9-12 feet) long, 0.6 m (2 feet) wide and operate at a depth of 15 cm (6"). Eggs may be held in baskets or trays in the troughs for incubation.



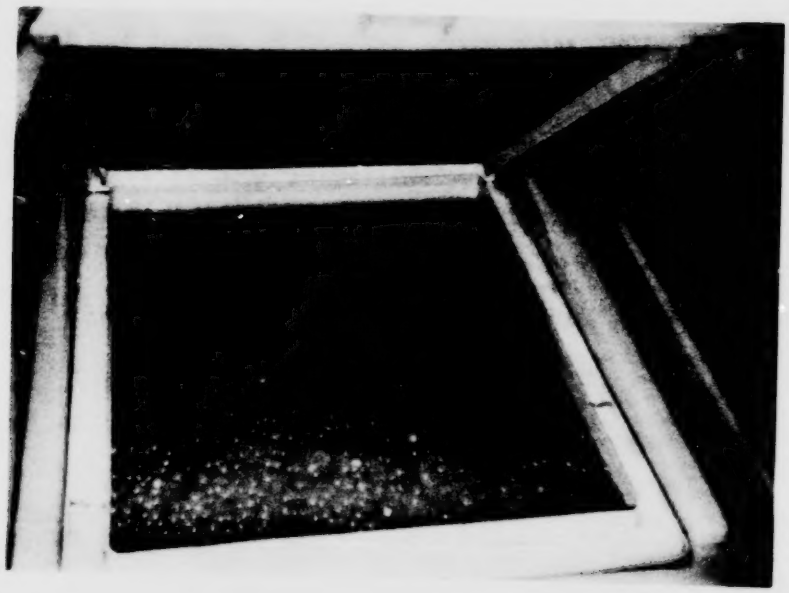
Schematic diagram of a trough with egg-incubation boxes.



Troughs used for early-rearing

vi) Hatching Units - Incubators

Eggs may initially be purchased and later produced on the farm after a broodstock population has been developed. Eggs are hatched in a variety of incubators, commercially produced, or home-made. Heath trays are a popular type of stacked incubator. The principle of hatching units is identical to that of the rearing units -- water must flow past the eggs at a sufficient rate to provide adequate oxygen levels and remove the metabolic wastes produced by the eggs as they develop. At the same time, undue agitation of the eggs is avoided. Since low volumes of water are used for incubation and early rearing, it may be cost-effective to raise the water temperature at these stages. An increase in growth at this time will shorten the total time to grow the fish to market size.



Stacked tray incubators. These are made by Heath-Tecna. Eggs are held in the tray and covered by a screen. Water moves up through the eggs and screen to an overflow. The water then passes to the tray below.

vii) Carrying Capacity

It is common to see a combination of all of the above types of units in any one aquaculture operation. It should be remembered that rates of water turnover are of greater significance in determining production capacity than is the absolute volume of rearing units. A significant exchange of water is required to replenish oxygen levels and remove waste products. For example it is recommended that optimum water replacement time for raceways is 20-30 minutes (2-3 changes per hour - although this rate of exchange is rarely achieved because of low water availability). This allows adequate oxygen levels to be maintained while providing a flushing action without forcing the fish to swim against an excessive current which may reduce their growth. By considering such factors as flow rate, rearing unit volumes, water temperature, size of fish and expected growth rate, it is possible to estimate a "carrying capacity" (maximum number of fish of a specific size which can be raised in a given rearing unit,) for any particular situation. Such calculations will not be reviewed here. The concept of "carrying capacity" should be understood if optimum use of any facility is to be made; it is discussed in several of the references cited in Appendix 6.

**Feeds and Feeding**

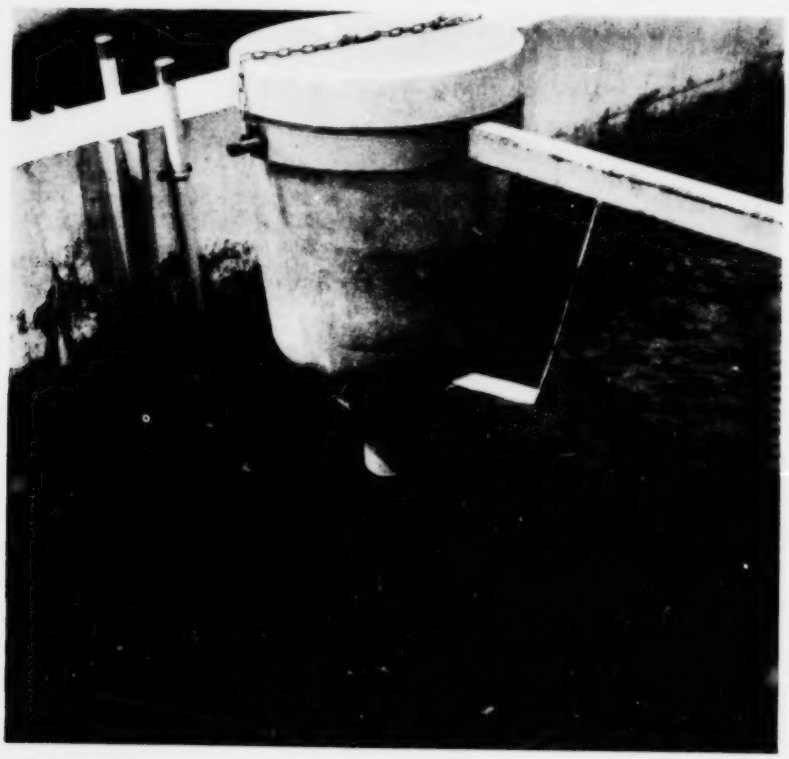
Considerable research has been devoted to developing trout feeds. This has resulted in the general availability of good quality commercial fish feeds. One Ontario animal-feed manufacturer (Martin Feed Mills, Elmira, Ontario, N3B 3A2, Tel. 519-669-5171) presently produces a complete line of fish feed. These feeds are produced in various sizes to suit the fish as they grow. Fish feeds are more expensive to produce than feeds for other domestic animals as they require more care in manufacture and contain higher levels of protein and fat. Trout are able to convert this feed to flesh efficiently, 1.5 kg of feed producing 1 kg of fish on average. This is a conversion of dry feed to 'wet' fish. On a dry weight basis the conversion is about 4.5 to 1. Therefore the fish produce a large amount of excreta which may cause water quality problems, (see section 6). The cost of feed represents 40-70% of the costs of fish production in Ontario.

The feeding of animals that live in water obviously poses more problems than feeding those that live on land. The fish farmer must ensure that feed is actually consumed by the fish and not wasted resulting in poor weight gain and degradation of water quality. Although this sounds simple in concept, some innovation has been required to solve feeding problems.

The amount of feed consumed by fish depends upon water temperature and body size. The Table in Appendix 11 may be used as a guide. Actual feeding rates may vary considerably from this model and will have to be modified for individual situations. Smaller fish consume more feed per day (expressed as a percentage of body weight) than do larger fish and feed must be presented to them more frequently. Fry up to 1 gram should be fed 2-3 times an hour from one hour before day-break to one hour after sundown. This feeding rate can be reduced gradually as the fish grow until only 2 to 3 feedings per day are required for yearling fish and 1 feeding per day for broodstock.

To reduce the labour involved in feeding fish, automatic feeders and demand (pendulum) feeders are often used. Automatic feeders have clocks which allow feed to be released to the fish at specific intervals. Demand feeders release feed when the fish move a rod which extends from the feed container into the water. Fish learn to use these feeders very quickly.

Demand feeders have some advantages over other methods. They reduce labour involved in feeding; fish eat throughout the day; more uniform growth is achieved; lowering of oxygen levels caused by the vigorous feeding activity associated with periodic feedings is avoided, resulting in more uniform water quality. Both automatic and demand feeders are available commercially or can be home-made.



A demand feeder mounted on a raceway wall.

**The Production Cycle**

A hypothetical production cycle which reflects growth conditions typical for Ontario trout is depicted in the figure below. This figure is intended only to introduce terminology and the approximate time required for the various stages of the production cycle. At individual facilities the production cycle will vary depending on whether eggs are produced on site, or eggs/young fish are bought from another source. Water quality conditions, especially temperature, also contribute to the range in production times at Ontario trout farms.

Terminology

Green egg - recently fertilized egg. These may be transported for up to 48 hours after fertilization if necessary. Great care must be taken in shipment.

Eyed eggs - eggs in which the eye of the developing egg is clearly visible. Most eggs are transported at this stage.

Sac-fry - eggs have hatched but the yolk has not yet been absorbed. Also called alevins.

Fry - free-swimming -- yolk sac absorbed.

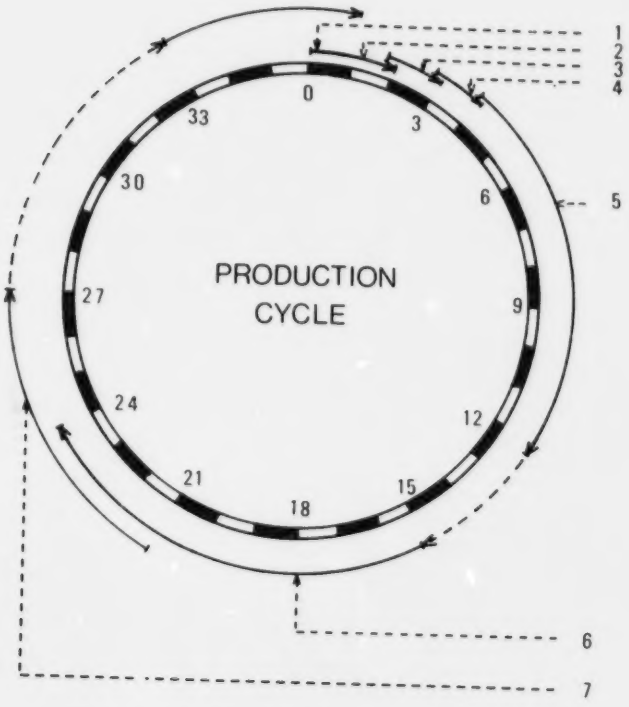
Fingerlings - 5-15 cm (2"-6") fish - suitable for stocking.

Table stock - (table-size, plate-size) - 9"-11" fish weighing 8-12 ounces, (225-300 g.) suitable for restaurant or retail markets.

Brood stock - mature fish, 2-3 years of age which may be used for spawning for 2-3 years.

MODEL PRODUCTION CYCLE FOR RAINBOW TROUT IN ONTARIO

(TIME IN MONTHS)




1 Green eggs
2 Incubation period
3 Sac-fry
4 Fry
5 Fingerlings
6 Table stock
7 Broodstock

**Fish Health**

Fish are susceptible to a number of viral, bacterial, and protozoan diseases. This susceptibility is increased in the crowded, often poor hatchery environment. The water environment allows fish diseases to spread rapidly and makes treatment difficult.

Disease incidence can be minimized in the hatchery by using "clean" water sources, i.e. those that do not contain wild fish populations which may harbour diseases. Maintaining high water quality (in particular dissolved oxygen levels), keeping crowding to a minimum, and introducing only "disease free" fish to the facility, are other measures which will reduce disease incidence.

Should a disease occur despite these measures, disease diagnosis and advice on treatment may be obtained at a nominal cost from the Pathology Department, Ontario Veterinary College, Guelph (Appendix 12). One private company which can offer diagnostic services and advice on treatment is Aquatic Pathology Services, 65 Clive Ave., Guelph, Ontario, N1E 3S5 (519) 833-2989 or 821-0767.

The necessity for disinfection should be considered in the design of a fish culture facility. For example, materials which are easily disinfected should be used wherever possible and rearing units should have the option of being completely drained to allow a complete clean-up.

## 4. ECONOMICS OF PRODUCTION

### INTRODUCTION

The economics of trout production in Ontario are typical of any other commercial agricultural enterprise. The levels of capital investment and operating expenses are significant, with returns (i.e., profitability) subject to the vagaries of the marketplace (e.g., import competition) and the business skills of the producer.

To study the economics of trout farming, a simple cost-of-production-model of a hypothetical fish farm has been constructed. The data for the model were collected from interviews with several commercial trout producers, discussions with fish biologists, engineers and a review of a previous OMAF study. The reader is cautioned against interpreting the results as a definitive portrayal of the production costs and revenues associated with trout production in Ontario. The development costs of any two farm sites can vary markedly. Moreover, the costs of individual components of the farm will be quite variable and may be expected to change from year to year.

This brief study of the economics of trout production serves as a guideline to determine the equipment requirements and the costs and prices that might be expected in establishing a trout farm.

### MODEL

The hypothetical fish farm was constructed with the following characteristics:

1) Free-flowing water (e.g., spring) was available at the rate of 1125 litres (250 gallons) per minute;
2) An additional 1125 litres (250 gallons) per minute were to be pumped from a ground source;
3) The farm was within 80 kilometers (50 miles) of Guelph;
4) Simple production technology (e.g., ponds vs. raceways) was used in the rearing of trout;

5) Used equipment was purchased or constructed (e.g., tanks) on site whenever possible;
6) 22,700 kilograms, average live weight of 325 g, (50,000 pounds, average live weight of 3/4 lbs) of trout to be raised each year - a sufficient production level to employ the owner/operator full time.

The model assumes that fingerlings are purchased all at once and reared through to full market weight 12 months later. Although in actual practice, the purchase and sales would be staggered to ensure that an inventory of different-size fish was maintained and most efficient use of the water supply was made. This assumption is sufficient to illustrate the revenues and costs associated with rearing 22,700 Kg., (50,000 pounds) of fish over a 12 month period.

**ANALYSIS**

Based on the estimates of capital expenditures, operating costs and revenues found in Tables 2 and 3, the trout farm generated $18,500 as a net return to operator labour, management, risk and equity capital. This level of net return is considered modest in view of the investment costs and risks associated with trout production in Ontario.

The sources of revenue for the farm consist of direct sales to consumers at the farm, supplying live fish to owners of recreational fish ponds, and deliveries to the Ontario Trout Producers' Cooperative (processing and marketing cooperative). Alternative marketing channels such as direct sales to the Hotel, Restaurant and Institution trade also exist. The proportion of sales to any one of these marketing channels (i.e., co-op, farm sales) is dependent upon such factors as product quality, continuity of supply, location of the farm and the marketing "savvy" of the owner/operator. As a rule, the returns are greatest for direct sales to consumers and/or to owners of recreational fish ponds. However, these markets remain limited in size in comparison to channeling product to retail chains through such organizations as the Cooperative.

It is apparent from Tables 2 and 3 that four cost components are significant in the commercial production of trout, namely, feed, fingerlings, interest and insurance costs. It is constructive to examine each of the four in more detail.

In regard to feed costs, it is true that trout have an excellent feed conversion ratio (1.5 kilograms feed for every kilogram of gain). However, trout require expensive, high protein feed. Therefore, the feed component of rearing trout will always account for a significant proportion of the total cost of production.

The high cost of fingerlings can be partially offset by the purchase of eggs instead and the rearing of trout from the egg stage to market weight. Further savings might be realized with the producer acquiring brood stock and producing his/her own eggs. The benefits of keeping broodstock will have to be weighed carefully as the cost of their maintenance - feeding, diverting water from production - may be more than their worth as an egg source. Certain advances in cost control in this area could come about as the producer became more proficient and experienced in the management and culturing of trout.

The interest cost on borrowed money, both short and long-term, represents a signficant outlay of funds, particularly for the investor starting out with limited financial resources. The interest cost on working capital would be expected to drop as cash flow patterns are improved through more precise timing of feed and materials purchases and the timing of product sales throughout the year.

Finally, in excess of $15,000 has been spent on insurance (including a premium cost of $6,000 for loss of stock), and back-up systems (generator, spare aerators) to guard against potential problems (e.g., interruption of electrical power). The cost of such protection is viewed as unavoidable if the owner lacks the financial resources to survive a complete loss of inventory.

**TABLE 2 ESTIMATED CAPITAL INVESTMENT FOR 1985**

| | Amount |
|---|---|
| 4 hectare parcel of land with 1125 litres (250 gallons) per minute water source @ $5,000/ha | 20,000 |
| Construction of a new building (uninsulated) to house trout production facilities, concrete floor | 30,000 |
| Building wiring, plumbing (including plastic pipe) | 6,000 |
| Electrical service to site | 8,000 |
| Tanks for rearing and growing[a] | 9,500 |
| Excavation and preparation of head (1), settling (1), waste (1) and earth ponds (6) | 10,000 |
| Used back-up generator (service 10 hp system), including installation | 7,500 |
| 6 aerators (including spares) | 3,000 |
| Purchase and installation of pump to handle 1125 litres (250 gallons) per minute water flow | 3,500 |
| Used one-ton truck | 8,000 |
| Construction of trailer equipped to move live fish | 2,000 |
| 8" concrete pipe, concrete work and miscellaneous plastic pipe | 2,500 |
| **TOTAL CAPITAL INVESTMENT** | **110,000** |

[a] Includes the construction of homemade early rearing and two sizes of circular tanks, each equipped with concrete bottoms and drains.

**TABLE 3 - REVENUE AND EXPENSE STATEMENT**

| | Amount |
|---|---|
| **REVENUE** | Dollars |
| Farm sales, 20% of production @ $6.60/kg ($3/lb.) live weight | 30,000 |
| Sales to Guelph Cooperative, 60% of production @ $3.40 kg ($1.55/lb.) live weight[a] | 46,500 |
| Stocking sales, 20% @ $8.80/kg ($4/lb.) live weight | 40,000 |
| **TOTAL REVENUE** | **116,500** |
| **VARIABLE EXPENSES** | |
| Fingerlings 10 cm (4"), 67,000 @ 30¢ apiece | 20,100 |
| Feed[bc], | 19,400 |
| Mortality and culling (.008%/month) - fingerling and feed cost losses | 2,500 |
| Labour[d] | 6,500 |
| Insurance[e] | 6,900 |
| Repairs and maintenance[f] | 5,500 |
| Hydro | 2,000 |
| Interest on working capital @ 13-1/2% | 9,300 |
| Transportation[g] | 4,000 |
| Chemicals and drugs | 500 |
| Office supplies and telephone | 600 |
| Accounting fees | 500 |
| **TOTAL VARIABLE EXPENSES** | **77,800** |
| **FIXED EXPENSES** | |
| Depreciation: Buildings, $30,000 @ 5% | 1,500 |
| Pumps, electrical wiring, aeration equipment, 28,000 @ 20% | 5,600 |
| Ponds and tanks $19,500 @ 20% | 3,900 |
| Interest on long-term debt[h] 12% of $77,000 | 9,200 |
| **TOTAL FIXED EXPENSES** | **20,200** |
| **TOTAL VARIABLE AND FIXED EXPENSES** | **98,000** |
| **NET RETURN TO OPERATOR LABOUR, MANAGEMENT, RISK AND EQUITY CAPITAL** | **18,500** |

[a] There may be costs (i.e., membership fee) associated with selling to the Cooperative.
[b] Grower ration (4p, 5p, 6p), feed conversion of 1.5:1.
[c] Includes cash and bulk discounts and delivery costs.
[d] One-half man year @ $7/hour.
[e] Includes liability, fire and theft coverage and death loss (premium of 5% of value of fish).
[f] 5% of total investment.
[g] Includes depreciation, repairs, insurance and gasoline.
[h] Assuming a 30/70 debt-equity ratio.

## 5. OVERVIEW OF THE LEGAL REQUIREMENTS

Commercial aquaculture in Ontario is controlled by various legislation and regulations administered by both the Federal and Ontario Governments. The legal requirements applicable to fish farming in Ontario are detailed below. In addition to satisfying the requirements which concern the culture and sale of fish and the construction of fish rearing facilities, certain laws concerning the establishment and siting of a business must also to be addressed.

### Ontario Ministry of Natural Resources

#### 1. Obtaining a Licence to Culture and Sell Fish

A prospective fish farmer in Ontario must apply for and obtain a Licence which allows him to grow and sell fish, from the local District Office of the Ontario Ministry of Natural Resources. (A list of District Office addresses is contained in Appendix 3) Initial issuance of the licence depends on investigation and favourable recommendation by OMNR District field staff. This investigation is conducted to ensure that the property in question conforms to the following definitions and that activities associated with the proposed fish farm will be unlikely to affect wild fish populations. The licence must be renewed annually and the current cost is $31.50 (1986).

i) The land on which the fish farm is located must be owned or leased by the applicant.

ii) Water supplied to the fish rearing facilities may be derived from natural springs or groundwater, or water diverted or pumped from a stream or lake, (subject to restrictions applied under the Lakes and Rivers Improvement Act and the Ontario Water Resources Act).

iii) Fish may not be raised in natural streams. Natural ponds or lakes may only be used if the bed is owned by the applicant and no water flows from the lake or pond into any other natural body of water.

iv) In certain cases, a portion of the bed of a lake (which is owned by the Crown) may be leased for the purpose of rearing fish in cages or net pens in the water column above. The lessee would then be eligible to apply for a licence to culture and sell fish.

## II. Fish Species Which May be Cultured

At present (1985) regulation limits fish culture in Ontario to four species: rainbow trout, brook trout, largemouth bass and smallmouth bass. Only rainbow trout and brook trout may be sold for human consumption. An additional number of species (Appendix 8) may be cultured and sold once the legislation restricting the number of species to those above has been amended. Not all of these species may be raised in all parts of the province and culture and/or stocking is subject to approval by individual Districts. Restrictions on the transfer, stocking or culture of fish species are made to prevent their introduction or spread into waters where they may compete with, and displace, other valuable commercial or sport fish.

## III. Transfer of fish

Before a sale or transfer of live fish is made, a Permit to Transfer Fish must be issued by the District Office of OMNR to which the fish are destined. This free permit can be obtained by either the vendor or the purchaser. Once a Transfer Permit has been issued, subsequent transfers involving the same purchaser and the same body of water and species of fish, need only be documented by the issue of a receipt by the vendor to the purchaser, i.e., Transfer Permits are not required for every transaction.

## IV. Other Legal Considerations

In the construction of a facility to culture fish, several laws of general application not specifically designed for fish farming in particular must be considered. OMNR administers the Lakes and Rivers Improvement Act. Under this Act, any proposal to undertake work that holds back, forwards, or diverts a natural water course must be assessed and approved by the

OMNR. There are two steps in obtaining a Permit from the District office of OMNR to undertake such work. The location of the dam or weir must be approved and subsequently, the plans and specifications must be approved. Such approvals are seldom granted especially if the damming involves a cold water stream.

The local Conservation Authority should be contacted as it is responsible for regulations such as the flood and fill regulations that may affect the establishment of a fish farm. Similarly, Municipal offices should be contacted to determine whether the effluent from the fish farm will enter a municipal drain or may cause drainage or flooding problems.

A licence holder may not sell fish if they are infected by agents that cause the following diseases: bacterial kidney disease, infectious pancreatic necrosis, viral hemorrhagic septicemia, infectious hematopoetic necrosis, whirling disease, enteric redmouth disease, ceratomyxosis and proliferative kidney disease, without the written permission of the Minister of Natural Resources, (Ontario regulations). In this case provision may be made for the sale of these fish for human consumption only. A licence holder is exempt from the requirement of a licence to use a seine or dip net on his premises.

## V. Operation of Fishing Preserves

A Licence to Own and Operate a Fishing Preserve allows the owner or lessee of a parcel of land, with a water body, to stock that water body with fish from a fish farm or caught under a Commercial Fishing Licence. A fishing preserve is defined as an artificial or man-made body of water lying wholly within the boundaries of privately-owned land, containing water from surface run-off, natural springs, groundwater, or water diverted or pumped from a stream or lake, but not composed of natural streams, ponds or lakes or water impounded by the damming of natural streams. The licence must be obtained from the District office of OMNR in which the fishing preserve is to be located. It exempts the holder and all persons angling on the premises from closed seasons and daily catch limits.

The Licence costs $63.00 and it must be renewed at the beginning of each calendar year. All fish removed from the licenced premises must be accompanied by a receipt stating that the fish originated from that fishing preserve.

**Ontario Ministry of the Environment (OME)**

OME administers the Ontario Water Resources Act. Under this Act, any project, including commercial aquaculture, requires a Permit to Take Water, if the volume taken is over 50,000 liters (10,000 gallons) per day. A Certificate of Approval for an effluent treatment works is also required under the Act to ensure that the environment will not be adversely affected by the proposed facility.

In general, the Ministry of the Environment is concerned with any activity which will have an impact on the quantity and quality of Ontario's water resources. Hence, the fish hatchery effluent, after mixing with the receiving water, must not cause the receiving water quality to deteriorate such that the Provincial Water Quality Objectives, specified in the OME Water Management booklet, are violated. (For the source of this booklet, see Appendix 6).

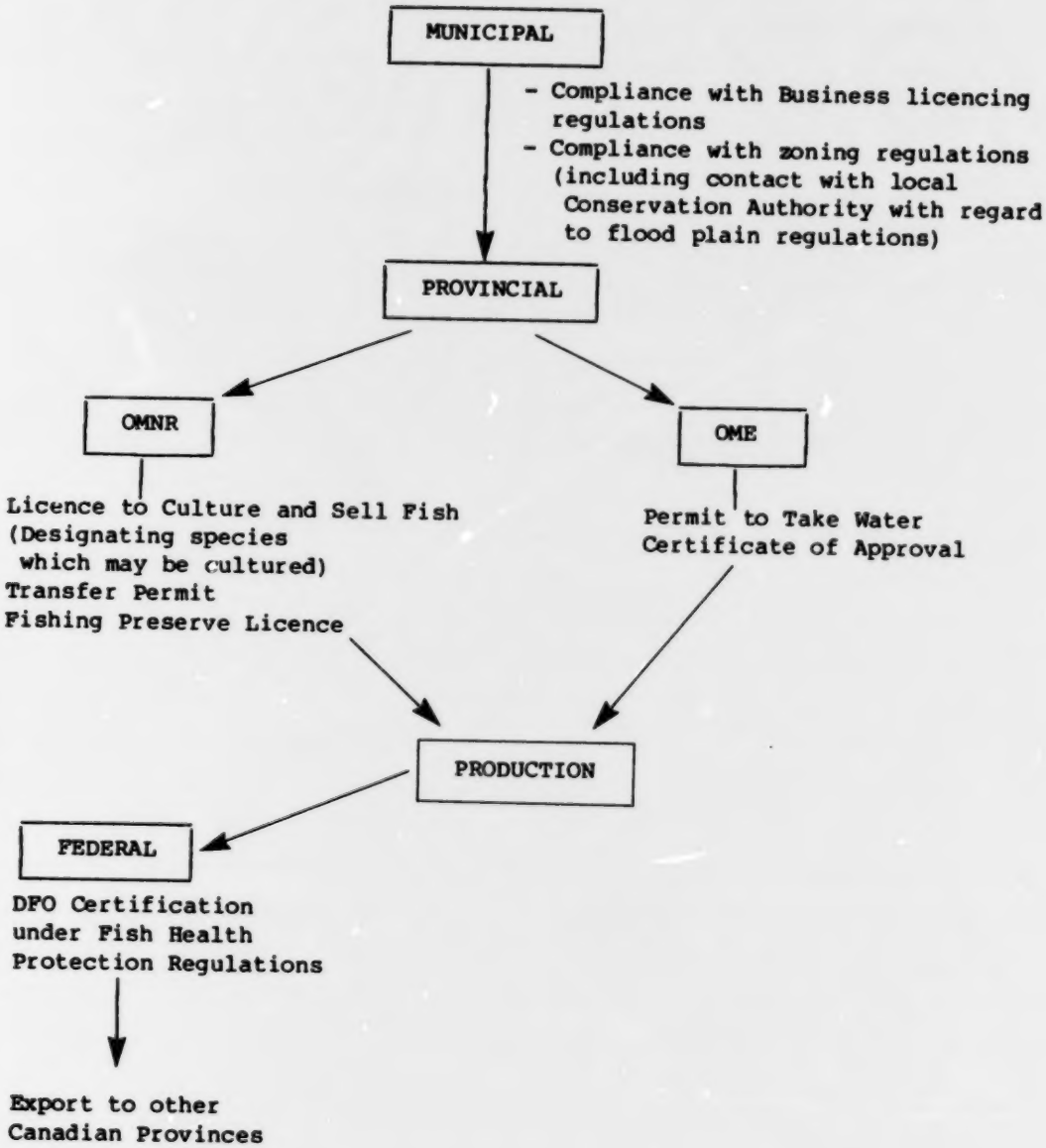
Please note that: by law, the OME requires that approval be granted before construction is commenced on any commercial or industrial facility that produces any waste water discharge from the operation of that facility. This applies independently of those regulations administered by the OMNR (above). Any person who begins construction before obtaining approval is in contravention of the law and is liable to prosecution. It is to the applicant's advantage to submit completed applications as early as possible to allow Ministry staff sufficient time to review the proposal. Application forms are available at any District or Regional OME office. Section 6 of this document is devoted to a discussion of OME concerns and guidelines are provided which explain how to apply for the permits.

Many pesticides and herbicides are controlled under the Pesticides Act and their use may require a permit. Compounds for killing fish (piscicides) are also regulated by OME. The OME Regional Pesticides Officer should be contacted for information.

**Department of Fisheries and Oceans**

The Federal Fish Health Protection Regulations made under the Fisheries Act are administered by both Federal and Provincial Government offices to minimize the risk of introducing new fish diseases and spreading existing ones in Canada. These Regulations apply to fish culturists rearing mainly salmonids (salmon and trout) who: 1) operate facilities in Canada from which live cultured fish or eggs, dead cultured fish, or eggs of wild fish are to be shipped between provinces; 2) operate facilities in a country outside of Canada from which the above categories of fish and eggs are to be imported into Canada. The Local Fish Health Officer (LFHO) of the receiving province or region in Canada may issue an Import Permit to allow the movements of fish described above into that province or region. (In Ontario, the LFHO is the supervisor, Fish Culture Section OMNR.) These decisions are based on the health status of the exporting facility which is determined by a Fish Health Official (FHO), a qualified and approved fish pathologist, through a schedule of inspections and standardized diagnostic procedures. A facility can become certified under this program of inspections by the FHO. This certification must be maintained during scheduled, semi-annual inspections. Details of this program are given in the Manual of Compliance, Fish Health Protection Regulations, (see appendix 6 for source). It is not essential that fish farmers in Ontario have their facilities certified. However, if export to other provinces is anticipated, certification will be required. In addition, fish to be used for scientific studies generally require disease-free status.

**The "Permit Pathway"**


MUNICIPAL
- Compliance with Business licencing regulations
- Compliance with zoning regulations (including contact with local Conservation Authority with regard to flood plain regulations)
PROVINCIAL
OMNR
OME
Licence to Culture and Sell Fish
(Designating species which may be cultured)
Transfer Permit
Fishing Preserve Licence
Permit to Take Water
Certificate of Approval
PRODUCTION
FEDERAL
DFO Certification under Fish Health Protection Regulations
Export to other Canadian Provinces

The above is the sequence which may be followed by a proponent. OMNR approvals are conditional upon OME approvals. However, applications may be made to these agencies at the same time in order to speed up the process. It is not unusual for the approvals procedure to take up to one year.

## 6. POLLUTION POTENTIAL OF FISH FARMS

**Introduction:**

As mentioned earlier in this booklet, the Ontario Ministry of the Environment is concerned with any activity which may lead to a deterioration of water quality in Ontario.

Fish farm effluents, although generally dilute, are of large volume and can have long-term accumulative effects on the receiving water. The effluents can at times contain deleterious loadings of nutrients, solids and oxygen-demanding materials especially during specific procedures such as clean-out. Therefore, fish farms can have a significant adverse impact upon the waters receiving these wastes. Such wastes may be classified as:

- chemicals and drugs employed for the cleaning and/or the control of diseases parasites and aquatic weeds within the facility;
- bacteria and parasites which may be harboured in the hatchery and subsequently released; and,
- fish fecal matter and residual food, and soluble products such as ammonia produced through fish metabolism.

Chemicals and drugs employed for the control of diseases and parasites are normally transitory having a minimal persistence in the natural environment. Therefore, they are not considered to constitute a pollution problem. However, the use of herbicides to control aquatic weeds in natural and artificial earthen ponds could have an effect on downstream water uses. The OME Regional Pesticides Officer should be contacted prior to their use.

The possible release of bacteria and parasites has traditionally not been considered to be a problem since facility operational procedures are such that the generation of pathogens should be minimal and any outbreak immediately controlled.

The pollutants of most concern which are discharged from fish rearing operations are fish fecal matter and residual food. Whether or not the release of these materials can be termed significant, depends upon the concentrations at which they are released and the assimilative capacity and other characteristics of the receiving water. Normally, fish farms are located near sources of high quality water, and even small concentrations of pollutants could have a significant impact on the quality of the receiving water.

**Wastes Generated:**

The aim of commercial fish farming is to produce the largest amount of fish possible within the constraints imposed by limited water availability. In any fish farm, an attempt is made to achieve an optimum balance between water flow, volume of rearing area, fish density, and feeding rate. It is the input of fish feed which determines the level of wastes generated, as approximately 70% of the feed used is passed through the fish as undigested fecal material or metabolic products such as ammonia. Through good feeding practices (not over-feeding, screening the feed before use), waste feed itself should not contribute significantly to the total waste load.

The daily (eg. cleaning) and yearly (e.g., periods when fish are held at maximum loading) operational procedures on any individual fish farm will cause fluctuations in the concentration of wastes in the effluent. However, the total yearly output of wastes can be estimated based on the total amount of feed fed. Wastes generated during shorter time periods can also be predicted (means of estimating waste production are presented in Appendix 10).

**Waste Characteristics:**

Two general types of waste are produced by fish; solid, particulate material referred to as settleable solids and suspended solids, and soluble substances such as phosphorus and the nitrogen-containing compound, ammonia, which is a product of protein metabolism. Soluble nitrogen and phosphorus in the effluent from a fish farm are readily available nutrients for aquatic plants and algae. The solid particulate

material is also rich in nitrogen and phosphorus. However, this material must undergo decomposition before these plant nutrients become available. In addition to acting as a "store" of plant nutrients, the particulate material uses oxygen as it decomposes (the amount of oxygen used in this decomposition is called the Biochemical Oxygen Demand - BOD). Therefore, removal of the solids generated from a fish farm is a major step in improving effluent quality. The technology required to accomplish this removal is not difficult to apply.

In the normal operation of a fish farm, there is a continual removal of most suspended and settleable solids as they are carried out of the rearing area by the water flow. A certain accumulation of fecal material, unused feed, algae, and other detritus also occurs in the rearing units. This material may decompose and release soluble nutrients which can not be effectively removed by downstream treatment such as settling. Therefore, periodic removal of this material before it begins to undergo decomposition is necessary. These cleaning wastes cause temporary but marked decreases in effluent quality.

**Treatment Technology:**

The focus of effluent treatment is to remove settleable solids and suspended solids to the greatest extent possible.

a) Settling or Discharge Pond:

The entire flow from fish farms may be passed into a large pond or lagoon which has sufficient volume to retain the total amount of water which would flow through the facility for at least one hour. This allows removal of as much as 90 percent of the settleable solids and 45 percent of the suspended solids. A two hour settling time is recommended. This would remove 80% of combined settleable and suspended solids. The ultimate disposal of accumulated solids may be a major operating problem, since, in order to maintain treatment efficiency, the solids must be removed periodically as they will decompose and release nutrients to the receiving stream. The accumulated material may be used as fertilizer on agricultural land. It is recommended that staff of the local OME office be contacted for advice on how to size and design the treatment system to handle the projected organic loading.

b) Cleaning Wastes Retention or "Holding" Pond:

If the facility is designed so that there is periodic removal of concentrated settled material (cleaning wastes) from the rearing units, for example by vacuuming, it is necessary to retain this concentrated material in a holding pond which has no outlet. Wastes from this holding pond would be pumped out periodically, as required, and used for fertilizer.

**Approvals Required from OME:**

i) Permit to Take Water.
The OME requires that a Permit to Take Water (PTTW) be obtained for the taking of a volume of water in excess of 50,000 liters (10,000 gallons per day).

The PTTW is required in order to monitor the use of water and prevent situations arising in which users of the same water source may come into conflict. It also monitors water use in different areas of the province. The application for the Permit to Take Water is relatively straightforward.

ii) The "Certificate of Approval":

An "Approval of Plans and Specifications for the Construction of Works for the Collection, Transmission, Treatment and Disposal of Liquid Industrial Wastes" (also known as a "Certificate of Approval") is required before construction or alteration is commenced on any facility which will create a waste water discharge. The application for the Certificate of Approval considers the amount of deleterious substances in the discharge and its predictable effect on receiving waters.

The OME has developed provincial water quality objectives which are specified in the OME Water Management booklet. The fish hatchery effluent, after mixing with the receiving water (lake, stream, river) must not cause the receiving water quality to deteriorate to the extent that the objectives are violated. Appendix 9 includes a sample form plus instructions for its completion.

## 7. POTENTIAL FINANCIAL AID

There are no outright grants available to potential fish farmers in Ontario. The Ontario Ministry of Agriculture and Food (OMAF) recognizes fish farming as a food producing activity. Therefore, those beginning an operation or engaged in fish farming, may be eligible for support under a variety of OMAF farm productivity programs in certain circumstances. Since these programs change from year to year, the OMAF Agriculture Representative in your area should be contacted to determine what assistance may be available (see Appendix 4).

The Federal Department of Supply and Services may give grants under the Unsolicited Proposals Program to proponents to develop novel ideas which may benefit the aquaculture industry in Canada. These are generally research-oriented projects.

The Ontario Ministry of Industry and Trade has, on occasion, provided funding for expansion of facilities and development of methods for increased production under existing incentive programs. Financial incentives for small business change from year to year with the retiring of ongoing programs and the introduction of new ones. Applications for financing through the programs will be judged on the same basis as applications for starting any business - i.e., potential for success and increasing employment.

As can be seen from the above, the potential fish farmer must basically rely on his own resources and initiative in financing an aquaculture enterprise. However, programs do change. So it is worthwhile to contact possible supporting agencies. See appendix 12 for contact addresses.

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## APPENDIX 1

## MINISTRY OF NATURAL RESOURCES

## LIST OF THOSE LICENCED TO PROPAGATE AND SELL BASS AND TROUT, 1985

Name and Address of Licencee

Michael Barabash, R.R. #2, Kettleby, Ontario L0G 1J0
David Barbour, R.R. #2, Hillsburgh, Ontario N0B 1Z0
Lloyd Bauman, Cedar Springs Trout Farm, R.R. #1, Waterloo, Ontario N2J 4G8
Harold Leslie Bell, Box 16, Site 1, R.R. #1, Waubaushene, Ontario L0K 2C0
Blue Spring Trout Farms Ltd., Mr. Orval Ford, R.R. #1, Hanover, Ontario N4N 3B8
Bowen Springs Inc., Box 1152, Waterford, Ontario N0E 1Y0
Clark Laverne Brander, Box 152, Clinton, Ontario N0M 1L0
Gus Brienesse, R.R. #3, Everett, Ontario L0M 1J0
R. Bruce & Anne-Marie Holdsworth, R.R. #4, Woodstock, Ontario N4S 7V8
T.L. Cashman, R.R. #7, Pembroke, Ontario K8A 6W8
Fred H. Chalkley, Chalkley Trout Farms, R.R. #3, Puslinch, Ontario N0B 2J0
Robert Charter, R.R. #3, Blyth, Ontario N0M 1H0
Gord Cole, Box 245, Parry Sound, Ontario P2A 2X4
Steven C. Cooke, Box 296, Clinton, Ontario N0M 1L0
Tony W.J. Cosh, R.R. #4, Stirling, Ontario K0K 3E0
Darlene A. Cox, Mimosa Springs Trout, Div. of Cox Farms Ltd., R.R. #4, Rockwood,Ont. N0B 2K0
Creekbank Trout Farm Ltd., Box 182, Elmira, Ontario N3B 2Z5
Antonio Cristiano, R.R. #2, Dundalk, Ontario N0C 1B0
Crooked Creek Trout Farm, R.R. #7, Pembroke, Ontario K8A 6W8
Larry G. Cryderman, Rainbow Ranch, R.R. #1, Moffat, Ontario L0P 1H0
Ivan Wm. Davie, Glennwood Trout Hatchery, R.R. #1, Ashburn, Ontario, L0B 1A0
Anthony De Coensel, R.R. #1, Simcoe, Ontario N3Y 4J9
Joan & Marcel De Witte, R.R. #1, Burgessville, Ontaro N0J 1C0
Karl Heinz Dickob, Box 29, Kinmount, Ontario K0M 2A0
Jerry Doyle, R.R. #4, Mount Brydges, Ontario N0L 1W0
Anton Drescher, R.R. #1, Otterville, Ontario N0J 1R0
William John Dunstan, Fiddlehead Trout Farm, R.R. #2, Caledon, Ontario L0N 1C0
Paul William Durst, R.R. #2, St. Williams, Ontario, N0E 1P0
Wallace S. Eady, R.R. #1, Cobden, Ontario K0J 1K0
Harvey Eaket, Box 75, Iron Bridge, Ontario P0R 1H0
Henry B. Engeneski, Box 33, Scotland, Ontario N0E 1R0
F.G.W. Holdings, P.O. Box 1032, Kirkland Lake, Ontario P2N 3L1
Paul and Ron Feden, R.R. #14, Thunder Bay, Ontario P7B 5E5
Earl Edmund Fenwick, R.R. #4, Flesherton, Ontario N0C 1E0
Alvis Fogels, Springhills Trout Farm, R.R. #1, Holland Centre, Ontario N0H 1R0
465421 Ontario Limited, T/A Blyth Acres Trout Farms, Pres. D.G. Elliott, Box 130, Blyth, Ont N0M 1H0
Klaus Friesecke, Cold Spring Trout Farm, R.R. #4, Orangeville, Ontario L9W 2Z1
Ralph Gansekoele, R.R. #5, Guelph, Ontario N1H 6J2
"Gordon" George & Gordon "Lynn", Stanley Gehring, R.R. #2, Otterville, Ontario N0J 1R0
Kurt Gelder, Pineridge Trout Hatchery R.R. #1, Kendal, Ontario L0A 1E0
Andre Glaude, R.R. #1, Rockland, Ontario K0A 3A0
Goodwin & West Company Limited, c/o W.A. West, 30 Kennedy St. West, Aurora, Ont. L4G 2L5
Mary Lou A. Goold, R.R. #1, Wilsonville, Ontario N0E 1Z0
Goossens Trout Farm Ltd., R.R. #2, Otterville, Ontario N0J 1R0
Werner E. Grusshaber, R.R. #8, Jerseyville Road, Brantford, Ontario N3T 5M1
Stan Grygiel, R.R. #3, Barrie, Ontario L4M 4S5
Guelph Fishing Club, Box 186, Guelph, Ontario N1H 7A1
Matti Hannikainen, R.R. #2, Burks Falls, Ontario P0A 1C0
Richard Harlocks, Box 127, Gogama, Ontario P0M 1W0
John Harrington, Halton Hills Trout Farms Ltd., R.R. #5, Milton, Ontario L9T 2X9

Douglas Heal, R.R. #1, Rosseau, Ontario P0C 1J0
David D. Hedley, R.R. #1, Belgrave, Ontario N0G 1E0
John Holder, (Franklin Trout Farm Ltd.), R.R. #1, Mount Albert, Ontario L0G 1M0
Adrien Achiel Jacques, R.R. #1, La Salette, Ontario N0E 1H0
Terry Jesse, R.R. #4, Shelburne, Ontario L0N 1S0
Garnet and Jean Kay, R.R. #1, Rockwood, Ontario N0B 2K0
Henry Kemp, R.R. #2, Colborne, Ontario K0K 1S0
Orland Knowles, R.R. #6, Wiarton, Ontario N0H 2T0
Adolf Kopp, Shady Hatchery, R.R. #7, Brighton, Ontario K0K 1H0
Murray Kuno, Box 182, Haliburton, Ontario K0M 1S0
Augustin LaCroix, R.R. #1, Perkinsfield, Ontario L0L 2J0
Douglas Lee, R.R. #1, Fenelon Falls, Ontario K0M 1N0
Limnos Limited, 591 Liverpool Road, Pickering, Ontario
Robert A. Livingstone, 124 Cedar Street, Collingwood, Ontario L9Y 3A6
James T.D. Main, P.O. Box 388, Sundridge, Ontario P0A 1Z0
Teofil Malecki, R.R. #2, Brantford, Ontario N3T 5L5
Harold Mallon, R.R. #1, Stratford, Ontario N5A 6S2
Basil Marchildon, General Delivery, Penetang, Ontario L0K 1P0
Clair G. Marchildon, R.R. #3, Penetang, Ontario L0K 1P0
Orvel Maxwell, R.R. #1, Stirling, Ontario K0K 3E0
Bob Maynard, R.R. #1, Cavan, Ontario L0A 1C0
Terry J. McManus, Spring Valley Garden, 401 Fife's Road, R.R. #2, Peterborough, Ont K9J 6X3
Helmut Mundt, R.R. #3 , Komoka, Ontario N0L 1R0
Noreen Neilson, Caledon Mountain Trout Club, Inglewood, Ontario L0N 1K0
Opeongo Mountain Trout Farm, (Jane Strickland & Reg. Guinther) R.R. #4, Eganville, Ontario K0J 1T0
Charles A. Parker, Parker's Trout Farm, R.R. #21, Ronzell Road, Cambridge, Ontario N3C 2V3
Alexander Plomp, Aquafarms Canada Ltd., Feversham, Ontario N0C 1C0
Neil Plummer, Spring Water Farm, R.R. #6, Cambridge, Ontario N1R 5S7
Edward and Dianna Pritchard, R.R. #3, Pakenham, Ontario K0A 2K0
Murray Pucula, R.R. #2, Thorndale, Ontario N0M 2P0
Jim Rawn, Box 1015, North Bay, Ontario P1B 8K3
Theresa Raymond, Trout Haven Park, R.R. #3, Strathroy, Ontario N7G 3H5
John G. Reekie, R.R. #1, Parry Sound, Ontario P2A 2W7
Dianna Rennie/Nelson Phillips/Michael Phillips, Highland Spring Trout Farm, Walters Falls, Ontario N0H 2S0
Nigel and Marjory Robbins, Trillium Springs Fish Farms Ltd., R.R. #2, Holland Centre, Ont. N0H 1R0
Venard H. Robitaille, Box 164, Mactier, Ontario P0C 1H0
Franz Roessl carrying on business under the name of "Franz's Old Country Butcher Shop", 172 Lansdowne St. East, Peterborough, Ontario K9J 1Y7
Thomas Charles Sevier, R.R. #1, Princeton, Ontario N3T 5V6
James A. Sheldon, R.R. #2, St. Marys, Ontario N0M 2V0
Keith Sherman, R.R. #2, Chiblow Road, Iron Bridge, Ontario P0R 1H0
Herb Scholten, R.R. #1, Moorefield, Ontario N0G 2K0
Jack H.W. Simons, R.R. #4, Scotland, Ontario N0E 1R0
Murray W. Smith, R.R. #4, Picton, Ontario K0K 2T0
Paul Sowrey, R.R. #1, Emsdale, Ontario P0A 1J0
Thomas Stanfield, Tom's Place, R.R. #2, Hillsburgh, Ontario N0B 1Z0
Joanne Stevenson, Rainbow Springs Hatchery, R.R. #2, Thamesford, Ontario N0M 2M0
George E. Stoddart, R.R. #2, Holland Centre, Ontario N0H 1R0
Stephen Stoll, R.R. #4, Aylmer, Ontario N5H 2R3
Ferdinand Tagwerker, Spring Valley Trout Farm, R.R. #2, Petersburg, Ontario N0B 2H0
James D. Taylor, Linwood Acres Trout Farms, Ltd., R.R. #1, Campbellcroft, Ontario L0A 1B0
Sam Thistle, R.R. #4, Eganville, Ontario K0J 1T0
W.D. Thompson, Shamrock Springs Trout Farm Ltd., Box 434, Erin, Ontario N0B 1T0
Dalton E. Tiffin, R.R. #5, Orangeville, Ontario L9W 2Z2

Kenneth V. Tiffin, Midhurst Trout Hatchery, R.R. #1, Midhurst, Ontario L0L 1X0
Clifford Tosh, R.R. #1, Stratford, Ontario N5A 6S2
Norman Tosh, R.R. #1, Puslinch, Ontario N0B 2J0
G. John Turingia, Cedar Spring Park, R.R. #4 , Orangeville, Ontario L9W 2Z1
Mervin F. Turner, R.R. #2, Stouffville, Ontario L0H 1L0
Twin Rox Associates, 440 East 13th Street, Hamilton, Ontario L9A 4A5
Rolph Uhde, R.R. #6, Bracebridge, Ontario P0B 1C0
Tony Van Galen, R.R. #5, Waterford, Ontario N0E 1Y0
Peter Van Kruistum (Van Aqua Inc.), R.R. #4, Brantford, Ontario N3T 5L7
Gayle E. Watson, Bighead River Trout Ltd., R.R. #6, Owen Sound, Ontario N4K 5N8
William Webster (Bill's Bait), 534 Upper James St., Hamilton, Ontario L9C 2Y2
Wildcat Trout Farm, Middleton Street, Box 393, Thamesford, Ontario N0M 2M0
Russell Williams, Aranby Trout Farm, P.O. Box 1491, Guelph, Ontario N1H 6N9

NOTE: Not all of the above licencees are actually engaged in the business of selling trout

## APPENDIX 2

## ONTARIO TROUT FARMERS' ASSOCIATION
## 1985 MEMBERSHIP LIST
## (EXPIRES MARCH, 1986)

### - ACTIVE MEMBERS ONLY -
### (LICENCED FISH FARMS)

### (as of October 21, 1985)

Adrien Achiel-Jacques Jr., R.R. #1, La Salette, Ontario N0E 1H0 [519] 879-6835
Alp's Creek Trout Farm, Bob Charter, R.R. #3, Blyth, Ontario N0M 1H0 [519] 523-9546
Aqua-Cage Fisheries Ltd., Gord Cole & Stan Fairchild, Box 245, Parry Sound, Ont. P2A 2X4 [705] 746-4005
Aquafarms Canada Ltd., c/o Sandy Gott, R.R. #1, Feversham, Ontario N0C 1C0 [519] 922-2817
Barbour Trout Farm, Dave Barbour, R.R. #1, Hillsburgh, Ontario N0B 1Z0 [519] 855-4912
Bighead River Trout Ltd., Gayle Watson, R.R. #6, Owen Sound, Ont. N4K 5N8 [519] 371-4608
Blue Springs Trout Farm, R.R. #1, Hanover, Ont. N4N 3B8 [519] 364-1065 or 369-6836
Caledon Mountain Trout Club, Frank Romanelli, Inglewood, Ont. L0N 1K0 [519] 927-5294
Camp Creek Trout Farm, Ab Boogerman, R.R. #3, Durham, Ont. N0G 1R0 [519] 369-3363
Cedar Springs Trout Farm, Lloyd Bauman, R.R. #1, Waterloo, Ont. N2J 4G8 [519] 742-2979
Drescher Farm, Anton Drescher, R.R. #1, Otterville, Ontario N0J 1R0 [519] 879-6694
Falkland Gamefish Farms, Mr. Tom Sevier c/o Darby Sportswear Ltd., 248 Colborne St., Brantford, Ontario N3T 1L9 [519] 752-7367
The Franklin Trout Farm Ltd.,John Holder, R.R. #1, 72 Franklin Road, Mount Albert, Ontario L0G 1M0 [416] 473-2116
Mr. Lynn & Gordon Gehring, R.R. #2, Otterville, Ont. N0J 1R0 [519] 879-6511
Giesen Family, R.R. #1, Denfield, Ontario N0M 1P0 [519] 666-1331
Glennwood Trout Hatchery, Ivan Wm. Davie, 9540 Dacman Rd. Ashburn, Ont. L0B 1A0 [416] 655-4352
Mary Lou Goold, 580832 Ontario Ltd., R.R. #1, Wilsonville, Ontario N0E 1Z0 [519] 443-7595
Goosen's Trout Farm Ltd., Rene Goosens, R.R. #2, Otterville, Ont. N0J 1R0 [519] 879-6854
Haliburton Trout Farms, Murray Kuno, Box 182, Haliburton, Ontario K0M 1S0 [705] 457-2753
Halton Hills Trout Farms Ltd., John Harrington, R.R. #5, Milton, Ont.L9T 2X9 [416] 877-3730
Highland Spring Trout Farm Ltd., Michael Phillips or Dianna Rennie, Walters Falls, Ontario N0H 2J0 [519] 538-3175
Fred Howse, Box 1479, Penetang, Ontario L0K 1P0 [705] 526-4158
Kinmount Fish Farm, Karl Dickob, R.R. #1, Box 29, Kinmount, Ontario K0N 2A0 [705] 488-2660
Linwood Acres Trout Farm, Jim Taylor, R.R. #1, Campbellcroft, Ont. L0A 1B0 [416] 797-2484
Milford Bay Trout Farm, Rolf Uhde, R.R. #6, Bracebridge, Ont, P0B 1C0 [705] 764-1797
Norfolk Fisheries, Tony Decoensel, R.R. #1, Simcoe, Ont. N3Y 4J9 [519] 582-2757
Osprey Trout Farm, John Matheson or Ray Moore, R.R. #2, Clarksburg, Ont. [519] 599-2511
Outaouais Fish Farm, Andre Glaude, R.R. #1, Rockland, Ontario K0A 3A0 [613] 446-5057
Pine Ridge Trout Hatchery, Kurt Gelder, R.R. #1, Kendal, Ont. L0A 1E0 [416] 983-9513
Rainbow Haven Co., Anne Holdsworth, R.R. #4, Woodstock, Ontario N4S 7V8 [519] 424-
Rainbow Springs Hatchery, Joanne Stevenson, R.R. #2, Thamesford, Ont. N0M 2N0 [519] 283-6222
Rainbow Trout Hatchery, David Hedley, R.R. #1, Belgrave, Ontario N0G 1E0 [519] 357-2329
Jim Rawn, P.O. Box 1015, North Bay, Ontario P1B 8K3 [705] 776-2404
Shamrock Springs Trout Farms Ltd., Wayne Thomson, Box 434, Erin, Ont. N0B 1T0 [416] 833-9535
Sir Sanford Fleming College, Tim Arndt, Box 8000, Lindsay, Ont. K9V 5E6 [705] 324-9144
Springhills Trout Farm, Alvis Fogels, R.R. #1, Holland Center, Ont. N0H 1R0 [519] 794-3760
Spring Valley Trout Farm, Ferd Tagwerker, R.R. #2, Petersburg, Ont. N0V 2H0 [519] 696-3222
Springwater Trout Farm, Neil Plummer, R.R. #6, Cambridge, Ontario [519] 621-5549
George Stoddart, R.R. #2, Holland Centre, Ontario N0H 1R0 [519] 794-2214
Thistle Springs Trout Farm, Sam Thistle, R.R. #2, Ashton, Ontario K0A 1B0 [613] 838-5695
Trillium Springs, Nigel Robbins, R.R. #2, Holland Centre, Ontario N0H 1R0 [519] 798-2684
Wild Cat Trout Farm, John McFarlan, Box 393, Thamesford, Ont. N0M 2M0 [519] 285-2897
Willow Creek Trout Farm, Marcel & Joan DeWitte, R.R. #1, Burgessville, Ont. N0J 1C0 [519] 424-2197

## APPENDIX 3

## MINISTRY OF NATURAL RESOURCES

## LIST OF OMNR DISTRICT OFFICES

### NORTHWESTERN REGION

**DRYDEN:** Box 3000, Dryden, Ontario P8N 3B3 (807) 223-3341
**FORT FRANCES:** 922 Scott Street, Fort Frances, Ontario P9A 1J4 (807) 274-5337
**IGNACE:** Box 448, Ignace, Ontario P0T 1T0 (807) 934-2233
**KENORA:** Box 5080, Kenora, Ontario P9N 3X9 (807) 468-9841
**RED LAKE:** Box 5003, Red Lake, Ontario P0V 2M0 (807) 727-2531
**SIOUX LOOKOUT:** Box 309, Sioux Lookout, Ontario P0V 2T0 (807) 737-1140

### NORTH CENTRAL REGION

**ATIKOKAN:** 108 Saturn Avenue, Atikokan, Ontario P0T 1C0 (807) 597-6971
**GERALDTON:** 208 Beamish Avenue, Geraldton, Ontario P0T 1M0 (807) 854-1030
**NIPIGON:** Box 970, Nipigon, Ontario P0T 2J0 (807) 887-2120
**TERRACE BAY:** Box 280, Terrace Bay, Ontario P0T 2W0 (807) 825-3205
**THUNDER BAY:** 435 James Street S., Box 5000, Thunder Bay, Ontario P7C 5G6 (807) 475-1521

### NORTHERN REGION

**CHAPLEAU:** 34 Birch Street, Box 460, Chapleau, Ontario P0M 1K0 (705) 864-1710
**COCHRANE:** 2 Third Avenue, Box 730, Cochrane, Ontario P0L 1C0 (705) 272-4365
**GOGAMA:** Box 129, Gogama, Ontario P0M 1W0 (705) 894-2000
**HEARST:** 631 Front Street, Box 670, Hearst, Ontario P0L 1N0 (705) 362-4346
**KAPUSKASING:** 6 Government Road, Kapuskasing, Ontario P5N 2W4 (705) 335-6191
**KIRKLAND LAKE:** Box 129, Swastika, Ontario P0K 1T0 (705) 642-3222
**MOOSONEE:** Box 190, Moosonee, Ontario P0L 1Y0 (705) 336-2987
**TIMMINS:** 896 Riverside Drive, Timmins, Ontario P4N 3W2 (705) 267-7951

### NORTHEASTERN REGION

**BLIND RIVER:** Box 190, Blind River, Ontario P0R 1B0 (705) 356-2234
**ESPANOLA:** Box 1340, Espanola, Ontario P0P 1C0 (705) 869-1330
**NORTH BAY:** 222 McIntyre Street West, Box 3070, North Bay, Ontario P1B 8K7 (705) 474-5550
**SAULT STE. MARIE:** 69 Church St., Box 130, Sault Ste. Marie, Ontario P6A 5L5 (705) 949-1231
**SUDBURY:** Box 3500, Station "A", Sudbury, Ontario P3A 4S2 (705) 522-7823
**TEMAGAMI:** Box 38, Temagami, Ontario P0H 2H0 (705) 569-3622
**WAWA:** Box 1160, Wawa, Ontario P0S 1K0 (705) 856-2396

## ALGONQUIN REGION

**ALGONQUIN PARK:** Box 219, Whitney, Ontario K0J 2M0 (705) 637-2780
**BANCROFT:** Box 500, Bancroft, Ontario K0L 1C0 (613) 332-3940
**BRACEBRIDGE:** Box 1138, Bracebridge, Ontario P0B 1C0 (705) 645-5244
**MINDEN:** Minden, Ontario K0M 2K0 (705) 266-1521
**PARRY SOUND:** 4 Miller Street, Parry Sound, Ontario P2A 1S8 (705) 746-4201
**PEMBROKE:** Riverside Drive, Box 220 Pembroke, Ontario K8A 6X4 (613) 732-3661

## CENTRAL REGION

**CAMBRIDGE:** R.R. #1, Beaverdale Road, Cambridge, Ontario N3C 2V3 (519) 658-9355
**HURONIA:** Midhurst, Ontario L0L 1X0 (705) 728-2900
**LINDSAY:** 322 Kent Street West, Lindsay, Ontario K9V 2Z9 (705) 324-6121
**MAPLE:** Maple, Ontario K0J 1E0 (416) 832-2761
**NIAGARA:** Box 1070, Fonthill, Ontario L0S 1E0 (416) 892-2656

## SOUTHWESTERN REGION

**AYLMER:** 353 Talbot Street West, Aylmer, Ontario N5H 2S8 (519) 773-9241
**CHATHAM:** Box 1168, Chatham, Ontario N7M 5L8 (519) 354-7340
**OWEN SOUND:** 611 Ninth Avenue East, Owen Sound, Ontario N4K 3E4 (519) 376-3860
**SIMCOE:** 645 Norfolk Street, North Simcoe, Ontario N3Y 3R2 (519) 426-7650
**WINGHAM:** R.R. #5, Hwy. 4 South, Wingham, Ontario N0G 2W0 (519) 357-3131

## EASTERN REGION

**BROCKVILLE:** Box 605, Oxford Street, Brockville, Ontario K6V 5Y8 (613) 342-8524
**CARLETON PLACE:** 10 Findlay Avenue, Carleton Place, Ontario K7C 3Z6 (613) 257-5735
**CORNWALL:** 113 Amelia Street, Box 1749, Cornwall, Ontario K6H 5V7 (613) 933-1774
**NAPANEE:** 1 Richmond Boulevard, Napanee, Ontario K7R 3S3 (613) 354-2173
**TWEED:** 265 Metcalf Street, Tweed, Ontario K0K 3J0 (613) 478-2330

## APPENDIX 4

### ONTARIO MINISTRY OF AGRICULTURE AND FOOD
### AGRICULTURAL REPRESENTATIVES
### listed by County/District

**ALGOMA:** L.P. Ritchie, 1496 Wellington St. E., Sault Ste. Marie, Ont. P6A 2R1 (705)253-1161
**BRANT:** S.J. Paquette, 207 Greenwich St.,Brantford, Ont. N3S 2X7 (519) 759-4190
**BRUCE:** M.R. Bolton, Box 1330, Walkerton, Ont. N0G 2V0 (519) 881-3301
**CARLETON:** H.J. Stanley, 26 Thorncliff Pl., Nepean, Ont. K2H 6L2 (613) 828-9167
**COCHRANE N.:** C.D. Haverson, Experimental Farm, Kapuskasing, Ont. P5N 2X9 (705) 335-5828
**COCHRANE S.:** P. Sabourin, Box 608, Matheson, Ont. P0K 1N0 (705) 273-2509
**DUFFERIN:** T.P. Sullivan, R.R. #4, Orangeville, Ont. L9W 2Z1 (519) 941-3830
**DUNDAS:** R.A. Humphries, Box 488, Winchester, Ont. K0C 2K0 (613) 774-2313
**DURHAM EAST:** J.E. Finlay, 234 King St. E., Bowmanville, Ont. L1C 1P5 (416) 623-3348
**DURHAM WEST:** H.I. Bell, Box 309, Uxbridge, Ontario L0C 1K0 (416) 852-3328
**ELGIN:** D.A. Murray, 594 Talbot St., St. Thomas, Ontario N5P 1C7 (519) 631-4700
**ESSEX:** L.M. Weber, 46 Fox St., Essex, Ontario N8M 2S2 (519) 776-7361
**FRONTENAC:** E.R. Jennings, Box 651, 1055 Princess St., Kingston, Ont. K7L 1H3 (613) 547-3428
**GLENGARRY:** G.J. Smith, Box 579, Alexandria, Ontario K0C 1A0 (613) 525-1046
**GRENVILLE:** S. Leyenaar, Box 2004, Kemptville, Ontario K0G 1J0 (613) 258-3416
**GREY:** B.H. Tolton, 181 Toronto St. S., Markdale, Ontario N0C 1H0 (519) 986-2040
**HALDIMAND:** H.U. Bentley, Box 129, Cayuga, Ontario N0A 1E0 (416) 772-3381
**HALTON:** P. MacMaster, 17 Wilson Dr., Milton, Ontario L9T 3J7 (416) 878-2314
**HASTINGS:** W.D. Tipper, Box 340, Stirling, Ontario K0K 3E0 (613) 395-3393
**HURON:** D.S. Pullen, Box 159, Clinton, Ontario N0M 1L0 (519) 482-3428
**KENORA:** E.H. Lick, Ontario Government Bldg., Box 3000, Dryden, Ont. P8N 3B3 (807) 223-2415
**KENT:** B.G. Fraser, Box 726, 435 Grand Ave. W., Chatham, Ontario N7M 5L1 (519) 354-2150
**LAMBTON:** B.D. Boyle, Box 730, Petrolia, Ontario N0N 1R0 (519) 882-0180
**LANARK:** R.C. Bradford, 10 Sunset Blvd., Perth, Ontario K7H 2Y2 (613) 267-1063
**LEEDS:** C.A. Tanner, Box 635, Brockville, Ontario K6V 5H8 (613) 342-2124
**LENNOX & ADD.:** G.M. Mills, 41 Dundas St. W., Napanee, Ont. K7R 1Z5 (613) 354-3371
**MANITOULIN:** H.R. Hodder, Box 328, Gore Bay, Ontario P0P 1H0 (705) 282-2043
**MIDDLESEX:** D.E. Agar, 367 Ridout St. N., London, Ontario N6A 2P2 (519) 434-6811
**MUSKOKA & P.S.:** G.S. Mitchell, Box 130, Huntsville, Ont. P0A 1K0 (705) 789-8886
**NIAGARA N.:** C.B. Holden, Vineland Station L0R 2E0 (416) 562-4142
**NIAGARA S.:** R.D. Stork, 574 South Pelham St., Welland, Ontario L3C 3C6 (416) 732-7552
**NIPISSING:** C.A. Peloquin, 222 McIntyre St. W., North Bay, Ont. P1B 2Y8 (705) 474-3050
**NORFOLK:** K.M. Linington, Box 587, Simcoe, Ontario N3Y 4N5 (519) 426-7120
**NORTHUMBERLAND:** D.F. Young, Box 820, Brighton, Ont. K0K 1H0 (613) 475-1630
**OXFORD:** C.B. Matthews, Box 666, Woodstock, Ontario N4S 7Z5 (519) 537-6621
**PEEL:** D.B. Miller, 3 Elizabeth Street S., Brampton, Ontario L6Y 1P7 (416) 451-5474
**PERTH:** A.W. Scott, 413 Hibernia St., Stratford, Ontario N5A 5W2 (519) 271-0280
**PETERBOROUGH:** J.R. Cockburn, 55 George St. N., Peterborough, Ontario K9J 3G2 (705) 745-2403
**PRESCOTT:** A. Pommainville, Box 110, Plantagenet, Ontario K0B 1L0 (613) 673-5115
**PRINCE EDWARD:** L.W. Matheson, Box 470, Picton, Ontario K0K 2T0 (613) 476-3224
**RAINY RIVER:** B.W. Ward, Front Street, Emo, Ontario P0W 1E0 (807) 482-2310
**RENFREW:** J.G. Young, 315 Raglan St. S., Renfrew, Ontario K7V 1R6 (613) 432-4841
**RUSSELL:** A.J. Lemay, 666 Rue Notre Dame, Box 540, Embrun, Ontario K0A 1W0 (613) 433-3391
**SIMCOE N.:** C.J. Nesbitt, Box 340, Elmvale, Ontario L0L 1P0 (705) 322-2231
**SIMCOE S.:** J.D. Lamble, Box 370, Alliston, Ontario L0M 1A0 (705) 435-5521
**STORMONT:** D.C. Miller, Box 655, 109-11th St. W., Cornwall, Ontario K6H 5T3(613) 933-1581
**SUDBURY:** A. Brunet, 1414 LaSalle Blvd., Sudbury, Ontario P3A 1Z6 (705) 566-1630
**TEMISKAMING:** N.R. Tarlton, Box "G", New Liskeard, Ontario P0J 1P0 (705) 647-6701
**THUNDER BAY:** W.R. Broadworth, Ont. Gov't. Bldg., 435 James St. S.,Thunder Bay, Ont. P7E 6E3 (807) 475-1631
**VICTORIA-HALIBURTON:** C.L. Hamilton, 322 Kent St. W., Lindsay, Ont. K9V 2Z9 (705) 324-6125
**WATERLOO:** G.H. Thompson, 279 Weber St. N., Waterloo, Ont. N2J 3H8 (519) 884-5390
**WELLINGTON:** M.T. Chamberlain, Box 159, Fergus, Ontario N1M 2W7 (519) 846-5371
**WENTWORTH:** W.D. Keys, R.R. #1, Ancaster, Ontario L9G 3K9 (416) 527-2995
**YORK:** E. Cavanagh, Newmarket Plaza, Newmarket, Ontario (416) 895-4519

## APPENDIX 5

## MINISTRY OF THE ENVIRONMENT
## LIST OF REGIONAL AND DISTRICT OFFICES

**NORTHWESTERN REGION:**

**Thunder Bay Regional Office** , P.O. Box 5000, 435 James St. S., Thunder Bay, Ontario P7C 5G6 (807) 475-1315
**Kenora District Office** , P.O. Box 5750, 808 Robertson St., Kenora, Ontario P9N 1X9 (807) 468-5578

**NORTHEASTERN REGION:**

**Sudbury Regional Office** , 199 Larch St., Sudbury, Ontario P3E 5P9 (705) 675-4501
**Timmins District Office** , 83 Algonquin Blvd. W., Timmins, Ont. P4N 2R4 (705) 264-9474
**Sault Ste. Marie District Office** , 445 Albert St. E., Sault Ste. Marie, Ontario P6A 2J9 (705) 949-4640
**North Bay District Office** , 1500 Fisher St., Northgate Plaza, North Bay, Ontario P1B 2H3 (705) 476-1001
**Parry Sound District Office** , 74 Church St., Parry Sound, Ontario P2A 1Z1 (705) 746-2139

**CENTRAL REGION:**

**Central Regional Office** , Suite 700, 150 Ferrand Dr., Don Mills, Ont. M3C 3C3 (416)424-3000
**Barrie District Office** , 12 Fairview Rd., Barrie, Ontario L4N 4P3 (705) 726-1730
**Muskoka-Haliburton District Office** , Hwy. 11, Gravenhurst, Ont. P0C 1G0 (705)687-3408
**Peterborough District** , 139 George St. N., Peterborough, Ontario K9J 3G6 (705) 743-2972
**Halton-Peel District Office** , 1226 White Oaks Blvd., Oakville, Ontario L6H 2B9 (416)844-5747

**SOUTHWESTERN REGION:**

**London Regional Office** , 985 Adelaide St. S., London, Ontario N6E 1V3 (519) 681-3600
**Windsor District Office** , 250 Windsor Ave., 6th Floor, Windsor, Ont. N9A 6V9 (519) 254-5129
**Sarnia District Office** , 242A Indian Rd. S., Suite 209S., Sarnia, Ont. N7T 3W4 (519)336-4030
**Owen Sound District Office** , 1180 20th St., Owen Sound, Ontario N4K 6H6 (519) 371-2901
**Chatham Sub-District Office** , 435 Grand Ave. W., Chatham, Ontario N7L 3Z4 (519) 352-5107

**WEST CENTRAL REGION:**

**Hamilton Regional Office** , Ont. Govt Bldg., 119 King St. W., Box 2112, Hamilton, Ont L8N 3Z9 (416)521-7640
**Cambridge District Office** , 400 Clyde Rd., P.O. Box 219, Cambridge N1R 5T8 (519) 623-2080
**Welland District Office** , 637-641 Niagara St. N., Welland, Ont. L3C 1L9 (416)735-0431

**SOUTHEASTERN REGION:**

**Kingston Regional Office** , 133 Dalton St., P.O. Box 820, Kingston K7L 4X6 (613) 549-4000
**Ottawa District Office** , 2378 Holly Lane, Ottawa, Ontario K1V 7P1 (613) 521-3450
**Cornwall District Office** , 4 Montreal Road, 2nd Fl., Cornwall K6H 1B1 (613) 933-7402
**Belleville District Office** , 15 Victoria Ave., Belleville K8N 1Z5 (613) 962-9208
**Pembroke Sub-Office** , 1000 MacKay St., Pembroke, Ontario K8A 6X1 (613) 732-3643

## APPENDIX 6

## REFERENCE BOOKS AND PUBLICATIONS ON AQUACULTURE

(Some of these titles may be available through public or university libraries.)

### BOOKS

| Title | Available From |
|---|---|
| Fish Hatchery Management by R.G. Piper, I.B. McElwain, L.E. Orme, J.P. McRaren, L.G. Fowler and J.R. Leonard | American Fisheries Society<br>5410 Grosvenor Lane<br>Bethesda, M.D.<br>20814 - 2199<br>U.S.A. |
| Trout and Salmon Culture by E. Leitritz and R.C. Lewis<br>Publications No. 4100 | Agricultural Sciences Publication<br>University of California<br>Berkeley, California<br>U.S.A. 94720 |
| Trout Farming Manual by J.P. Stevenson<br>Fish Farming Handbook by Evan Brown and John B. Gratzek<br>Trout Farming Handbook by S.D. Sedgwick | Scholium International Publishers<br>265 Great Neck Road<br>Great Neck, New York<br>U.S.A. 11021<br>(or enquire at a local bookstore to place an order) |
| The Freshwater Aquaculture Book by William McLarney | Hartley and Marks<br>Publishers, 3663 West Broadway<br>Vancouver, B.C. V6R 2B8 |

### MAGAZINES

| Title | Address |
|---|---|
| Aquaculture Magazine<br>(U.S. publication - American orientation - catfish, shrimp, trout, etc.) | Aquaculture Magazine<br>P.O. Box 2329<br>Asheville, North Carolina<br>U.S.A. 28802 |
| Fish Farmer<br>(British publication - largely salmon and trout production - similar technology to Canada) | Subscriptions Department<br>Clive H. Bullard<br>205 East 42nd Street<br>New York, New York<br>U.S.A. 10017 |
| Fish Farming International<br>(Reviews of international aquaculture - some emphasis on trout and salmon) | Subscriptions Department:<br>Canada House (Rear)<br>Kildare Close<br>Ruislip, Middlesex<br>United Kingdom<br>HA4 9XB |
| Farm Pond Harvest<br>(Articles on managing ponds for cold and warm water fish - four times a year) | Farm Pond Harvest<br>P.O. Box AA<br>Momence, Illinois<br>U.S.A. 60954 |

## MISCELLANEOUS PUBLICATIONS

| Title | Available From |
|---|---|
| Nutrition and Feeding of Rainbow Trout Canadian Special Publication of Fisheries and Aquatic Sciences #55 by J.W. Hilton and S.J. Slinger | Canadian Government Publishing Centre<br>Supply and Services Canada<br>Hull, Quebec K1A 0S9 |
| A Manual for Trout and Salmon Production by G.W. Klontz, P.C. Downey, and R.L. Focht | Sterling H. Nelson & Sons, Inc.<br>Murray Elevators Division<br>118 West 4800 South<br>Murray, Utah U.S.A. 84107 |
| Handbook of Fish Culture<br>This Handbook is under development. Copies have not yet been printed in sufficient quantitites for general sale or distribution. | Reference copies may be used at offices of OMNR Districts and OMAF Agricultural Representatives. |
| Nutrient Requirements of Coldwater Fishes (Nutrient requirements of domestic animals #16) | Printing and Publishing Office<br>National Academy of Sciences<br>2101 Constitution Avenue, N.W.<br>Washington, D.C.<br>U.S.A. 20418 |
| Nutrient Requirements of Warmwater Fishes and Shellfish (Nutrient requirements of domestic animals) | " " " " " |
| Trout Farming in Ontario - An Industry Study by H. Blum | Consumer Information Centre<br>Ontario Ministry of Agriculture and Food<br>801 Bay St.<br>Toronto, Ontario M7A 2B2 |
| Fish Farming by H. Blum | " " " " " |
| Construction and Management of Farm Ponds in Ontario<br>Publication #515 | " " " " " |
| Common Law Aspects of Water by R.W. Irwin | " " " " " |

| | |
|---|---|
| Problems with Farm Ponds by R.W. Irwin | Consumer Information Centre<br>Ontario Ministry of Agriculture and Food<br>801 Bay St.<br>Toronto, Ontario M7A 2B2 |
| Department of Fisheries and Oceans, 1984 Fish Health Protection Regulations: Manual of Compliance, Fish. Mar. Serv. Misc. Spec. Publ. 31 (Revised): 43p. | Department of Fisheries and Oceans<br>Fisheries Research Directorate<br>Aquaculture and Resource Development Branch<br>200 Kent St., 12th Floor<br>Ottawa, Ontario K1A 0E6 |
| Ministry of the Environment, 1984 Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment (The "Blue-Book") | Ontario Ministry of the Environment<br>Water Resources Branch<br>4th Floor, 1 St. Clair Ave. West<br>Toronto, Ontario<br>M4V 1K6 |
| Look to the Rainbow (a brochure on rainbow trout in ponds) | Ministry of Natural Resources<br>Public Information Centre<br>Room 1680, 99 Wellesley St. West<br>Toronto, Ontario<br>M7A 1W3 |
| Diseases of Pacific Salmon, Their Prevention and Treatment by J.W. Wood (A great deal of practical information on all aspects of salmonid culture - not just disease) | State of Washington, Department of Fisheries<br>Hatchery Division<br>115 General Administration Bldg.<br>Olympia, Washington<br>U.S.A. 98504 |
| Rainbow: A Computerized Simulation of Rainbow Trout Farming in Ontario (Useful both as an introduction to the various factors affecting productivity - rearing units, water quality etc., and as a practical tool for fish farmers. | John Joyner<br>Career Services<br>University of Guelph<br>Guelph, Ontario |

## APPENDIX 7

## ESTIMATION OF WATER AVAILABILITY

### I Direct Measurement

Collect the water flow in a container of known volume and determine the time required to fill the container.

For example, a 45 litre (10 gallon) pail is filled in 5 seconds.

Therefore the water flow is

$$\frac{45 \text{ litres}}{5 \text{ seconds}} \text{ (10 gallons) X 60 seconds} =$$

= 540 litres per minute or 120 gallons/minute

### II Measurement of Flow in Streams

For larger flows, a crude estimate of volume may be made as follows:

1. Choose a section of stream or spring flow where the water runs smoothly over an area of relatively equal depth and width. The section should be as long as practical.
2. Calculate the average water depth.
3. Calculate the average width of the stream.
4. Measure the time required for a small float (bobber) to pass from the top to the bottom of the chosen section. Do this four or five times to calculate an average time.

Given the above, the volume of water flow would be calculated as follows:

$$\text{flow} = \frac{D \times W \times L}{T} \times A \times 60^{1}$$

D is average depth
W is average width
L is length of the measured section
A is a factor to be used depending on the type of stream bottom;
smooth sand etc. = 0.9
rough rocks etc. = 0.8
T is time in seconds.
[1] 60 converts flow into volume per minute.

For example: D = 0.15 m (15 cm or 0.5 feet)
W = 1.0 m (3.25 feet)
L = 6.0 m (19.5 feet)
T = 20 seconds
A = 0.9

$$\text{flow (metric)} = \frac{0.15\text{ m} \times 1.0\text{ m} \times 6.0\text{ m}}{20} \times 0.9 \times 60$$

= 2.43 cubic meters per minute

= 2,430 liters per minute (There are 1,000 liters per cubic meter.)

$$\text{flow (imperial)} = \frac{0.5^{ft} \times 3.25^{ft} \times 19.5^{ft}}{20} \times 0.9 \times 60$$

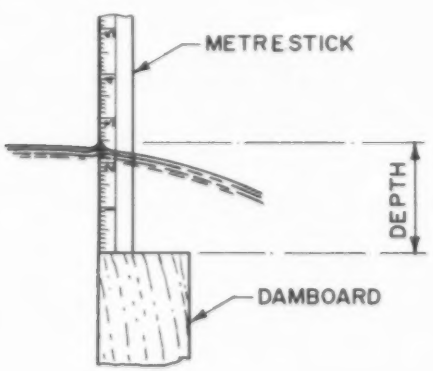
= 85.55 cubic feet per minute

= 538 gallons per minute
(multiply cubic feet by 6.25 to calculate gallons)

III Discharge of Water over Sharp-Crested Weirs
(Adapted from King's "Handbook of Hydraulics, 4th Ed., Table 36)

The following table is to be used for measuring the discharge of water over damboards or other similar weirs. The discharge must be free-flowing (not just trickling over and down the damboard) to use the table. The depth of the weir crest is measured to the top of the curl (see diagram) on the leading edge of a metrestick or yardstick when these are placed on the leading edge of the top damboard. After measuring the depth of the crest refer to the table and multiply the flow in gallons per minute by the length of the weir in feet.

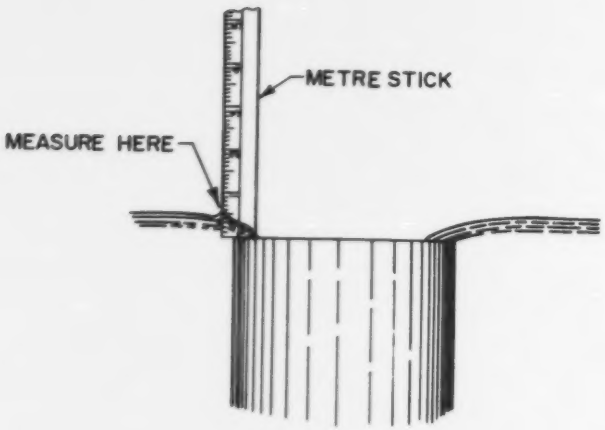
Example: The weir is 3.5 feet long and the crest is 2 inches.
The flow is 3.5 X 85 = 297.5 gallons per minute.



| Depth on Crest inches (cm) | | Discharge per Foot (30.5 cm) of Weir Crest Imperial gpm (Lpm) | | Depth on Crest inches (cm) | | Discharge per Foot (30.5 cm) of Weir Crest Imperial gpm (Lpm) | |
|---|---|---|---|---|---|---|---|
| 1/2 | (1.3) | 11 | (50) | 6 | (15.2) | 438 | (1971) |
| 3/4 | (1.9) | 20 | (90) | 1/4 | (15.9) | 466 | (2097) |
| 1 | (2.5) | 30 | (135) | 1/2 | (16.5) | 495 | (2228) |
| 1/4 | (3.2) | 42 | (189) | 3/4 | (17.2) | 524 | (2358) |
| 1/2 | (3.8) | 55 | (247) | 7 | (17.8) | 552 | (2484) |
| 3/4 | (4.5) | 69 | (310) | 1/4 | (18.4) | 583 | (2624) |
| 2 | (5.1) | 85 | (382) | 1/2 | (19.1) | 613 | (2758) |
| 1/4 | (5.7) | 101 | (454) | 3/4 | (19.7) | 644 | (2898) |
| 1/2 | (6.4) | 118 | (531) | 8 | (20.3) | 676 | (3042) |
| 3/4 | (7.0) | 136 | (612) | 1/4 | (21.0) | 708 | (3186) |
| 3 | (7.6) | 155 | (697) | 1/2 | (21.6) | 739 | (3326) |
| 1/4 | (8.3) | 175 | (787) | 3/4 | (22.2) | 772 | (3474) |
| 1/2 | (8.9) | 196 | (882) | 9 | (22.9) | 806 | (3627) |
| 3/4 | (9.5) | 217 | (976) | 1/4 | (23.5) | 840 | (3780) |
| 4 | (10.2) | 238 | (1071) | 1/2 | (24.1) | 874 | (3933) |
| 1/4 | (10.8) | 261 | (1174) | 3/4 | (24.8) | 910 | (4095) |
| 1/2 | (11.4) | 285 | (1282) | 10 | (25.4) | 943 | (4244) |
| 3/4 | (12.1) | 309 | (1390) | 1/4 | (26.0) | 979 | (4406) |
| 5 | (12.7) | 334 | (1503) | 1/2 | (26.7) | 1015 | (4568) |
| 1/4 | (13.3) | 359 | (1615) | 3/4 | (27.3) | 1052 | (4734) |
| 1/2 | (14.0) | 384 | (1728) | 11 | (27.9) | 1089 | (4900) |
| 3/4 | (19.7) | 411 | (1850) | 1/4 | (28.6) | 1127 | (5072) |
| | | | | 1/2 | (29.2) | 1163 | (5233) |
| | | | | 3/4 | (29.9) | 1202 | (5409) |
| | | | | 12 | (30.5) | 1241 | (5584) |

## IV Water Discharge Down Drainsumps

Water must be freely discharging at all times down the sump; "blowback" will result in increased depth and measurement will be meaningless. Depth of water is taken by standing the metre or yardstick on the lip of the standpipe and measuring the depth to the top of the water curlback on the leading edge (see diagram).




12" diam. = 3.14' crest
10" diam. = 2.62' crest
8" diam. = 2.09' crest
6" diam. = 1.57' crest

Flow in imperial gallons per minute (litres per minute)

| Depth on crest inches (cm) | 12" (30.5 cm) sump | 10" (25.4 cm) sump | 8" (20.3 cm) sump | 6" (15.2 cm) sump |
|---|---|---|---|---|
| 1/2 (1.3) | 35 (158) | 29 (131) | 23 (104) | 17 (79) |
| 3/4 (1.9) | 58 (261) | 49 (221) | 39 (176) | 29 (130) |
| 1 (2.5) | 94 (423) | 78 (351) | 62 (279) | 47 (212) |
| 1/8 (2.9) | 117 (527) | 98 (441) | 78 (351) | 58 (264) |
| 1/4 (3.2) | 129 (581) | 107 (482) | 85 (383) | 65 (290) |
| 3/8 (3.5) | 152 (684) | 127 (572) | 101 (455) | 76 (342) |
| 1/2 (3.8) | 175 (788) | 146 (657) | 117 (527) | 88 (394) |
| 5/8 (4.1) | 199 (896) | 166 (747) | 133 (599) | 100 (448) |
| 3/4 (4.5) | 222 (999) | 186 (837) | 149 (671) | 111 (500) |
| 7/8 (4.8) | 246 (1107) | 205 (923) | 164 (738) | 123 (553) |
| 2 (5.1) | 269 (1211) | 225 (1013) | 179 (806) | 134 (605) |
| 1/8 (5.4) | 292 (1314) | 244 (1098) | 195 (878) | 146 (657) |
| 1/4 (5.7) | 316 (1422) | 263 (1184) | 211 (950) | 158 (711) |
| 3/8 (6.0) | 351 (1580) | 293 (1319) | 234 (1053) | 175 (790) |
| 1/2 (6.4) | 374 (1683) | 312 (1404) | 250 (1125) | 187 (881) |
| 5/8 (6.7) | 398 (1791) | 332 (1494) | 266 (1197) | 199 (895) |
| 3/4 (7.0) | 433 (1949) | 361 (1625) | 290 (1305) | 217 (975) |
| 7/8 (7.3) | 468 (2106) | 390 (1755) | 312 (1404) | 234 (1053) |
| 3 (7.6) | 491 (2210) | 410 (1845) | 327 (1472) | 246 (1105) |

## APPENDIX 8

## LIST OF FISH SPECIES WHICH MAY BE CULTURED IN ONTARIO [1,2]

American eel (Anguilla rostrata)[3]
Arctic char (Salvelinus alpinus)[3]
Atlantic salmon (Salmo salar)[3]
Brook trout (Salvelinus fontinalis) - presently permitted
Brown trout (Salmo trutta)
Bullhead catfish (Ictalurus nebulosus)
Channel catfish (Ictalurus punctatus)
Chinook salmon (Oncorhynchus tshawytscha)[3]
Coho salmon (Oncorhynchus nerka)[3]
Common carp (Cyprinus carpio)[3]
Lake sturgeon (Acipenser fulvescens)
Lake trout (Salvelinus namaycush)
Lake whitefish (Coregonus clupeaformis)
Largemouth bass (Micropterus salmoides) - presently permitted
Pink salmon (Onchorhynchus gorbuscha)[3]
Rainbow trout (Salmo gairdneri) - presently permitted
Smallmouth bass (Micropterus dolomieu) - presently permitted
Splake (Salvelinus namaycush X Salvelinus fontinalis)
Walleye (Stizostedion vitreum vitreum)
Yellow perch (Perca flavescens)[3]
Minnows - Cyprinidae of Ontario, except goldfish
Suckers - Catostomidae native to Ontario.

[1] Culture or stocking of these species at a specific location will be subject to OMNR District approval.

[2] After proposed changes in legislation have occurred.

[3] Stocking of these species will not be permitted. They may be produced for human consumption only.

## APPENDIX 9

## COMPLETING THE APPLICATION FOR A CERTIFICATE OF APPROVAL

The form for the Application for a Certificate of Approval under the Ontario Water Resources Act has been designed to be used by all applicants, from multinational corporations to the smallest business operated on a part-time basis. The sections have been broadly-worded to cover all proposals; consequently, some of the requirements of this form may be confusing to the smaller operator. This guide will indicate the more important sections in this form with respect to fish hatcheries or fish farms. Information on sections not mentioned in this guide should also be included if available. A sample of an application form follows these instructions.

Preliminary Information:

A brief statement or resume of the company background leading up to, and introducing the current state of the operation, is useful and is recommended.

The applicant should specify whether he or she is the owner or if the applicant is an agent acting on the owner's behalf. If the latter, a letter authorizing the applicant to act on behalf of the owner should be included.

Check the appropriate box on the form to indicate whether this is an application for a new operation, or a modification or addition to an existing one.

5. Production Data:

Raw materials should be interpreted as total estimated annual feed consumption. Also give an estimate of amount used in the month of highest consumption and fish numbers and average weight. Give total estimated annual production in pounds (or kilograms).

6. Water Supply:

The water supply source (lake, river, ground water, etc.) and quantity of water required must be specified. If the operation uses more than 50,000 litres/day (10,000 gallons/day), an application for a Permit to Take Water is required.

7. Wastewater Disposal:

Wastewater (water containing waste feed, feces and other contaminants) quantities must be specified. These data will probably be based on the water supply information.

Also include a description of the type of cleaning operation to be used to remove wastes (e.g. vacuum in raceways, flushing etc.). The cleaning practices may also influence the anticipated effluent quality.

8. Specify Receiving Water:

a) Identify where effluents will be discharged, (river, lake, storm sewer, etc.).

b) If effluent is discharged to a surface water (eg. river, lake, pond, etc.), background information on the water quality and flow characteristics of the receiving water must be submitted. This information may be available through the appropriate MOE regional office.

10. Chemicals:

List cleaning agents and any other chemical additions or potential additions (spills) to the water.

11. Thermal Characteristics:

If a significant temperature change between influent water and effluent water is anticipated, please specify.

12. Characteristics of Effluent Before Treatment:

This would be an estimation based on annual feed consumption (see Appendix 10 for calculations). Before entry of effluent into a waste or settling pond.

13. Characteristics of Effluent After Treatment:

Describe the treatment system to be used, i.e. give dimensions and volume of settling ponds and their retention time. Calculate characteristics of effluent after treatment (see Appendix 10).

**Raceways and Circular Ponds:**

15. Proposed Effluent Quality Monitoring:

A monitoring program would be developed in conjunction with MOE staff upon submission of the application.

16. Complete if applicable.

19. Solid Wastes:

Complete if applicable and describe how these solid wastes would be disposed of (landfill, land spreading, etc.). Solid wastes include dead fish, and cleaning wastes.

20. and 21. Proposed Construction Starting and Completion Dates and Cost Estimate:

These sections must be completed, especially the capital cost breakdown of the treatment works.

Site Plans:

a) A key plan (map), (1:50,000) showing the location of the facility.

b) Size of the property to be used for the proposed facility, structure and nature of adjoining lands (land-use designation).

c) Topography of the property and adjoining lands including the elevation of the highest known flood levels.

d) Layout and size of the existing, proposed and future facility structures on the property showing the distances from property lines, structures and private residences on adjoining properties.

General Layout and Detail Plans

For each proposed facility, plans showing the following should be submitted:

a) Schematic process flow diagrams showing all waste flow streams in the proposed operation.

b) Hydraulic profiles through the proposed operation. The profile should be accurate and of adequate vertical scale to clearly show the top of tanks, channel and trough inverts, weirs and other features which directly affect the hydraulic gradient. The hydraulic gradient should be shown for the minimum and maximum flow rates.

APPENDIX 9 (continued)

SAMPLE CERTIFICATE OF APPROVAL

Ontario Ministry of the Environment

| FOR OFFICE USE |
| --- |
| APPLICATION NO. |
| ..... |
| DATE RECEIVED ..... |

**APPLICATION FOR THE APPROVAL OF PLANS AND SPECIFICATIONS FOR THE CONSTRUCTION OF WORKS FOR THE COLLECTION, TRANSMISSION, TREATMENT AND DISPOSAL OF INDUSTRIAL WASTEWATER**

**SECTION 24, THE ONTARIO WATER RESOURCES ACT**

NOTE:

(1) An application for approval shall contain the completed, attached questionnaire and appendices, and all plans, reports, etc., to satisfy items A to D below where applicable and shall be submitted in **duplicate**.

(2) Information on the Ministry's industrial pollution control policy, program and procedures is provided in the Information Brief, Environmental Approvals Branch and should be read prior to completing this form.

(3) **New mines and ore milling companies** are also required to complete the Ministry's Mineral Industries – Information Sheet Parts I - V.

(4) Companies establishing manufacturing or production facilities that may produce wastewater having potentially harmful waste characteristics are required to complete Biological and/or Receiving Water Quality Information Sheets together with such other information as the Ministry may require.

**A. Manufacturing Plant Process Description, Water Supply and Waste Disposal**

A flow diagram and a written description of the industrial manufacturing process in sufficient detail shall be submitted to indicate:

- Quantity and quality of service water used in a specific process or industrial operation (Item 6, see questionnaire)
- Quantity and measured or estimated quality of liquid waste streams arising from water or other liquid use (Items 7 and 11). In this regard, data such as bioassay results and/or data related to potential toxicity, taste and odour problems or fish tainting shall be submitted where applicable on any characteristic or component of the waste that may adversely affect the environment of the receiving watercourse.

Where the quantity and/or quality of the waste varies according to industrial operating procedure or production rate, the variation in rates of waste flow (average, maximum and minimum) and the maximum and average concentrations of the significant waste components shall be given.

**B. Report on Design of Proposed Waste Treatment Works**

Engineering reports on the proposed treatment works should be submitted and shall indicate:

- Expected flow and concentrations of liquid industrial wastes, and means of measuring, from all processes contributing to the treatment plant influent (Items 7 and 11).
- A flow diagram relating the proposed treatment processes.
- Function, capacity and operation of the individual components comprising the treatment facilities, and the system as a whole. Performance data should be given where possible.
- Quantities of treatment chemicals.
- Expected degree of reduction in pollutional load to be effected by the system. Supporting research or pilot plant data shall be given where possible.
- A statement setting forth the expected bacterial, physical, chemical and other known characteristics of the treated effluent (Item 13).
- Method of sludge disposal, and disposal of other solid or liquid process wastes.

**C. Physical Lay-Out**

1. A general arrangement or lay-out sketch of the property shall be submitted (to scale or approximate) to co-ordinate buildings, treatment or disposal works, property boundaries, municipal boundaries, effluent lines, points of discharge of outfalls in relation to the receiving water, and municipal sanitary sewer connections.

2. Also, drawings or sketches of plant areas in sufficient detail to indicate:
   - Size and location of industrial process equipment concerned.
   - Location and sizes of collection and transmission sewers including sewers transporting uncontaminated waters entering the treatment or effluent system. Existing sewers shall be differentiated from proposed sewers and direction of flow in sewers shall be shown.
   - Location of all equipment involved in the proposed treatment, control or disposal of wastes. Existing equipment shall be differentiated from proposed equipment.

**D. Plans of Treatment Works**

1. Engineering drawings shall include plans and profiles of each unit in the treatment or control system.
2. Plans and profiles of outfall sewers at the receiving water should also be submitted.

---

Under the Act, the undersigned, as owner [X] or agent [ ] , applies for approval of plans and specifications, submitted herewith for the construction of

new industrial waste treatment or control works ..... Fish Hatchery/Farm ..... [x]

a modification or addition to existing industrial waste works ..... [ ]

consisting of: (brief description of proposal as related to this application)

One lagoon 100' x 28' x 7' deep receiving a combined flow from two raceways of 500 gpm.

NOTE: the lagoon has a 4 hour settling time at the flow listed above.

and submits the following information:

1. Name of Applicant ..... John Smith Company ..... 321-1234
   (Company, corporation, owner) (telephone number)

   35 Avenue Street Townberg Wellington
   (postal address) (county)

2. Location of Industry ..... same as above
   (number, street, road or lot number, municipality, county)

   NOTE: For plants producing various products or having a number of waste producing operations, items 3 to 23 which follow, should cover only details concerned with the specific proposal under consideration, including all inter-related process and treatment systems.

3. Production Data (List principal materials used and products produced, giving volume, weight, or quantity per day, week or other production period.)

   Raw Materials ... Fish food, trout fingerlings 3" or 4" or trout eggs. Chemicals used for disease treatment and disinfection - occasional use.

   Products ... Table sized trout approximately 10" to 12" in length.

   Current Production Level ..... 0

   Future Production level and date .. 24,000 lbs. of fish 1st year of operation

4. Industrial Operating Schedule –

hours per day ..... 24 .....

days per week ..... 7 .....

weeks per year ..... 52 .....

indicate shift periods ..... N/A .....

5. Number of Employees:

Office (Admin., Management) ..... one .....

Production ..... one .....

6. Water Supply:

| | Source of Water | Litres Per Day Average | Maximum | Minimum |
|---|---|---|---|---|
| (a) Industrial Processes | ground water | 720,000 gpd. | | |
| | | | | |
| | | | | |
| (b) Cooling, Condensers, Compressors | | | | |
| (c) Drinking and Sanitary | | | | |
| (d) Other | | | | |
| TOTAL SUPPLY | | 720,000 gpd. | | |

If daily supply varies from above total, explain in appendix ..... ☐

NOTE: If water in excess of 50,000 litres per day is to be taken from other than a municipal water supply, approval is required from the Ministry's Water Resources Branch, Toronto. (Section 20, Ontario Water Resources Act).

7. Waste Disposal:

| | Origin of Wastes or Description | Litres Per Day Average | Maximum | Minimum |
|---|---|---|---|---|
| (a) Process Waste Streams (itemize) | Origin of wastes is from the raceways | 720,000 gpd. | | |
| | | | | |
| | | | | |
| | | | | |
| (b) Batch Discharges | Raceway cleaning batch discharge | 10,000 gpd. | | |
| | | | | |
| | | | | |
| (c) Cooling and Condenser Water | | | | |
| (d) Sanitary Sewage | | | | |
| (e) Other | | | | |
| TOTAL | | | | |

If combined daily waste flow for disposal varies from above total, explain in appendix ..... ☐

8. Proposed route to, and ultimate point of waste discharge (municipal sewer, surface drain, lake, river, pond, leaching pit, etc. Give name of surface drain, lake or river. If discharge is to a tributary, also give name of main watercourse).

(a) Process Wastes (itemize) From settling pond (lagoon) via a 10" pipe to the receiving stream (Trout Creek).

(b) Batch Discharges same as above

(c) Cooling and Condenser Water N/A

(d) Sanitary Sewage N/A

(e) Other

9. Where a new connection or an increased effluent discharge to a municipal sewer is proposed, municipal authorization is required. Has this authorization been obtained?

Yes ☐ No ☐

10. List all chemicals used, produced, stored, or otherwise present on plant property which could, by any means, drain, gain access or be discharged directly or indirectly in any effluent or waste flow leaving the plant or plant property.

| Name of Chemical | Use of Chemical in Plant | Amount Lost to Effluent or Watercourse |
|---|---|---|
| XYZ Cleaner | raceway cleaning | 10 gal./day as required |
| XYZ Antibiotics | maintain the health of the trout | |
| | | |
| | | |

See appendix for discussion ☐

11. **Thermal Characteristics**

(a) Water Supplies

What are the expected temperatures in °C of the industrial process and cooling water supplies outlined in Section 6?

| | (May – October) | | (November – April) | |
|---|---|---|---|---|
| Process: | Avg. 10 °C (50°F) | Max. ....°C | Avg. 6 °C (43°F) | Max. ....°C |
| Cooling: | Avg. ....°C | Max. ....°C | Avg. ....°C | Max. ....°C |

(b) Waste Streams

What are the expected temperatures in °C of the treated effluents or process wastewater and spent cooling water streams outlined in Section 7?

| Process or treated effluents (itemize) | (May – October) | | (November – April) | |
|---|---|---|---|---|
| | Avg. 11 °C (52°F) | Max. ....°C | Avg. 8 °C (46°F) | Max. ....°C |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Cooling water | | | | |

(c) If the waste streams listed in (b) are to be combined with existing waste discharges, what are the expected temperatures and volumetric flow rates of each combined discharge?

| Combined discharge description | (May – October) Avg.....°C | Max.....°C | (November – April) Avg.....°C | Max.....°C | Combine flow – Litres per day Avg. | Max. |
|---|---|---|---|---|---|---|
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |

12. **Expected Characteristics of Waste Effluents before treatment**

BOD - 9.5 mg/l, Suspended Solids - 22 mg/l, ammonia - 0.54 mg/l

See appendix for analytical detail ☐

13. Expected Characteristics of treated waste flows and final effluent

BOD - 7.1 mg/l

Suspended solids - 12.1 mg/l

Ammonia - 0.54 mg/l

See appendix for analytical detail ☐

14. Proposed method of treated effluent flow measurement

continuous flow recording device ☐

non-recording device covered elsewhere ☐

other ☐

see appendix ☐

15. Proposed Effluent Quality Monitoring Program (See Information Brief)

(a) automatic continuous sampling ☐

periodic composite sampling ☐

periodic grab samples ☒

Sampling frequency once per shift ☐ daily ☐ weekly ☐ monthly ☒ batch ☐

(b) Samples to be analyzed for

$BOD_5$ ☒ Suspended Solids ☒ pH ☒

Others. ammonia ☒ ..... ☐ ..... ☐ ..... ☐

See appendix for detail ☐

16. If a leaching pit, oxidation pond, or spray or land irrigation system is proposed, the distance to the nearest:

(a) Surface watercourse is ..... Metres

(b) Private well is ..... Metres

(c) Municipal well is ..... Metres

(d) Dwelling or built-up area is ..... Metres

17. Power failures indicate the number and duration of power failures during the past five years

number and dates N/A .....

duration of each .....

see appendix ..... ☐

18. Describe facilities that will be available or precautions that will be taken to prevent the discharge of untreated wastes or the discharge of any material that could impair the quality of the receiving water in the event of power failures, treatment plant mechanical failures or manufacturing plant equipment failures involving spills or leaks. (Items such as standby pumps, emergency holding tanks, spill ponds, etc., are to be included here.)

All flow must pass through the settling pond (lagoon) where the solids are settled out.

See appendix ..... ☐

19. Are any solid wastes, other than those which can be picked up by the local garbage collection agency, generated in the process:

Yes ☒ No ☐

If yes, describe nature and quantity Collected solids will be spread on the company land as fertilizer and soil conditioner.

20. Proposed starting date for construction of proposed industrial waste treatment or control works March 1986

Proposed completion date of works July 1986

21. Estimate of capital cost of proposed industrial waste treatment or control works .....

Breakdown of capital cost estimate

| | |
|---|---|
| Equipment | $ 28,000 |
| Labour | $ 25,000 |
| Land | $ 8,000 |
| Other | $ 5,000 |
| Total | $ 66,000 |

See appendix ..... ☐

Engineering Charges .....

Estimate of annual costs of operation .....

22. Describe the manner in which the proposed facilities are to be operated. (Operating procedures should include schedule of operation, manpower requirements, maintenance schedule, etc. Operator qualifications should also be indicated.)

covered elsewhere ..... Appendix ... ☐

23. Study of performance or operating efficiency of installed treatment system. State:

How and when will the performance evaluation program be carried out ... Routine effluent data will be made available to MOE staff on request ..... Appendix ... ☐

Who will make the evaluation ... MOE staff ..... Appendix ... ☐

Submitted in accordance with Section 24 and with the knowledge of Section 59, Ontario Water Resources Act.

Date ... November 1985

John Smith
(Printed Name of Officer of Owner)

(Signature)

Owner
(Title)

NOTE: If signed by an agent, written authorization duly executed by the proper officers of the owner must accompany this application.

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## CHECK LIST TO BE USED BY APPLICANT IN ASSEMBLING COMPLETED APPLICATION CONSISTING OF REPORTS, PLANS, DIAGRAMS, ETC.

(1) Engineering report on treatment works including the required information (item B) and appropriate appendices of the questionnaire ... ☒

(2) Flow diagram of manufacturing processes indicating origin of waste flows (item A) ... ☒

(3) Flow diagram of proposed waste treatment or control works (item B) ... ☒

(4) General arrangement drawing or sketch of plant property to coordinate buildings, treatment works, outfalls, etc. ... ☒

(5) Sewer layout drawing (items 4 and 5 may be combined on one drawing, if convenient) ... ☐

(6) Engineering drawings showing plans and profiles of each unit in the treatment or control system ... ☐

(7) Mineral Industries Information Sheet, if applicable ... ☐

(8) Application duly signed ... ☒

## APPENDIX 10

## CALCULATION OF EFFLUENT CHARACTERISTICS

Intensive culture of fish results in a discharge of organic and inorganic (phosphorus and nitrogen) material from fish excretion and respiration into receiving waters. Before a fish culture station is established, it is important to predict the amount of these materials that will result from the proposed fish production. Depending on the outflow of the operation and the quality and quantity of the flow of the receiving stream, it can be estimated whether the concentration of these materials will exceed guidelines established to protect water quality in the receiving stream.

The major factor determining the output of "polluting" materials from a fish farm is the amount and composition of feed used. Fish feeds in Ontario presently are of high quality with less indigestible matter than was formerly the case. Given the amount of feed used annually or in a shorter time period, the average concentration of deleterious material in the effluent can be calculated. The following presents an example of how to predict effluent characteristics.

The factors used to determine the amount of waste materials are given in Table 1.

Table 1 - Factors Used to Determine Waste Production from a Fish Culture Facility Based Upon Feed Consumption

| | | | |
|---|---|---|---|
| Total Settleable and Suspended Solids | - | 0.261 | unit weight of feed |
| Settleable and Suspended Phosphorus | - | 0.0054 | " " " " |
| Dissolved Phosphorus | - | 0.0022 | " " " " |
| Settleable and Suspended Nitrogen | - | 0.0064 | " " " " |
| Dissolved Nitrogen | - | 0.0317 | " " " " |
| Ammonia | - | 0.0383 | " " " " |

Example

A fish farm uses 250 imperial gallons per minute (IGPM) (1125 litres per minute). Annual production is 5680 kg (12,500 lbs.). Feed conversion ratio is estimated to be 1.5:1. Therefore, a total of 8520 kg. (18,750 lbs.) of feed will be used. In the month of highest feeding 3,000 kg. (6,600 lbs.) of fish will be held and will require 60 kg. (132 lbs.) of feed per day.

Table 2 - Predicted Effluent Characteristics of a Hypothetical Fish Farm

| Parameter | Total[1] Annual Prod$^{n}$ | Highest[2] Daily Prod$^{n}$ (kg) | Average[3] Yearly Conc$^{n}$ (mg/l) | Average[4] Yearly Conc$^{n}$ After Settling (mg/l) | Average[5] Peak Conc$^{n}$ (mg/l) | Conc$^{n}$ (Peak) After Settling (mg/l) |
|---|---|---|---|---|---|---|
| Settleable and Suspended Solids | 2224 | 15.7 | 4.0 | 0.8 | 9.5 | 2.0 |
| Settleable and Suspended phosphorus | 46 | 0.32 | 0.08 | 0.02 | 0.2 | 0.04 |
| Dissolved phosphorus | 19 | 0.132 | 0.03 | 0.03 | 0.08 | 0.08 |
| Settleable and Suspended nitrogen | 55 | 0.384 | 0.09 | 0.02 | 0.23 | 0.05 |
| Dissolved nitrogen | 270 | 1.90 | 0.5 | 0.5 | 1.15 | 1.15 |
| Ammonia | 326 | 2.3 | 0.6 | 0.6 | 1.4 | 1.4 |

1. Total annual feed consumed multiplied by the factors given in Table 1.

2. Total daily feed consumed multiplied by the factors in Table 1.

3. Total annual production of waste converted to milligrams (mg), i.e., Kg x 1,000,000 or lb. x 454,000 divided by the annual water flow in litres (gallons x 4.5) in this case.

   e.g. $$\frac{2225 \text{ kg} \times 1{,}000{,}000}{250 \times 4.5 \times 60 \times 24 \times 365} = 4.0 \text{ mg/l}$$

4. Eighty percent of settleable and suspended material is removed through settling for 2 hours.

5. Daily production of waste converted to mg. divided by daily total flow,

   e.g. $$\frac{15.7 \times 1{,}000{,}000}{250 \times 4.5 \times 60 \times 24} = 9.5 \text{ mg/l}$$

The "pollutant" of most concern is phosphorus. Ministry of the Environment guidelines call for total phosphorus concentration not to exceed 20 micrograms (ug)/l in lakes and 30 ug/l in rivers and streams. In our example above, a total of 0.12 mg/l of phosphorus will be carried out of the facility to receiving waters. This is four times the concentration recommended by OME as 0.12 mg/l is equal to 120 ug/l. The receiving water must, therefore, be capable of diluting the effluent to less than 30 ug/l. This will depend on the volume of flow of the receiving river and its phosphorus concentration.

## APPENDIX 11

**Feeding Rate Guidelines for Rainbow Trout** - Given as a Percent of Body Weight Based on Size of Fish and Water Temperature - Adapted from Leitritz and Lewis (1980)

| Water Temp. C° (F°) | Approximate Size in Centimetres (inches) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | <2.5 (<1.0) | 2.5-5 (1-2) | 5-7.5 (2-3) | 7.5-10 (3-4) | 10-12.5 (4-5) | 12.5-15 (5-6) | 15-18 (6-7) | 18-20 (7-8) | 20-23 (8-9) | 23-25 (9-10) | 25+ 10+ |
| | Approximate Weight in Grams | | | | | | | | | | |
| | <0.2 | 0.2-1.5 | 1.5-5 | 5-12 | 12-23 | 23-40 | 40-60 | 60-90 | 90-130 | 130-180 | 180+ |
| 2(36) | 2.7 | 2.2 | 1.7 | 1.3 | 1.0 | 0.8 | 0.7 | 0.6 | 0.5 | 0.5 | 0.4 |
| 3(38) | 2.9 | 2.4 | 2.0 | 1.5 | 1.2 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.5 |
| 4(40) | 3.2 | 2.6 | 2.2 | 1.7 | 1.3 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 |
| 5(41) | 3.3 | 2.8 | 2.2 | 1.8 | 1.4 | 1.1 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 |
| 6(43) | 3.6 | 3.0 | 2.5 | 1.9 | 1.4 | 1.2 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 |
| 7(45) | 4.0 | 3.3 | 2.7 | 2.1 | 1.6 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 | 0.7 |
| 8(47) | 4.3 | 3.6 | 3.0 | 2.3 | 1.7 | 1.4 | 1.2 | 1.0 | 0.9 | 0.8 | 0.7 |
| 9(49) | 4.7 | 3.9 | 3.2 | 2.5 | 1.9 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 |
| 10(50) | 5.2 | 4.3 | 3.4 | 2.7 | 2.0 | 1.7 | 1.4 | 1.2 | 1.1 | 1.0 | 0.9 |
| 11(52) | 5.4 | 4.5 | 3.6 | 2.8 | 2.1 | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 |
| 12(54) | 5.8 | 4.9 | 3.9 | 3.0 | 2.3 | 1.9 | 1.6 | 1.4 | 1.3 | 1.1 | 1.0 |
| 13(56) | 6.3 | 5.3 | 4.3 | 3.3 | 2.5 | 2.0 | 1.7 | 1.5 | 1.3 | 1.2 | 1.0 |
| 14(57) | 6.7 | 5.5 | 4.5 | 3.5 | 2.6 | 2.1 | 1.8 | 1.5 | 1.4 | 1.2 | 1.1 |
| 15(59) | 7.3 | 6.0 | 5.0 | 3.7 | 2.8 | 2.3 | 1.9 | 1.7 | 1.5 | 1.3 | 1.2 |
| 16(51) | 7.8 | 6.5 | 5.3 | 4.1 | 3.1 | 2.5 | 2.0 | 1.8 | 1.6 | 1.4 | 1.3 |
| 17(63) | 8.4 | 7.0 | 5.7 | 4.5 | 3.4 | 2.7 | 2.1 | 1.9 | 1.7 | 1.5 | 1.4 |
| 18(64) | 8.7 | 7.2 | 5.9 | 4.7 | 3.5 | 2.8 | 2.2 | 1.9 | 1.7 | 1.6 | 1.5 |
| 19(66) | 9.3 | 7.8 | 6.3 | 5.1 | 3.8 | 3.0 | 2.3 | 2.0 | 1.8 | 1.6 | 1.6 |
| 20(68) | 9.9 | 9.4 | 6.9 | 5.5 | 4.0 | 3.2 | 2.5 | 2.1 | 2.0 | 1.8 | 1.7 |

For example, calculate the daily ration for 50,000 fish of average five grams being held at 10°C (50°F)

Percentage of body weight to be fed = 3.4

Total weight of fish is 50,000 x 5 = 250,000 grams

Therefore, amount of feed to be fed is $250{,}000 \times \frac{3.4}{100}$ = 8,500 grams = 8.5 kilo (18.7 lbs)

These percentages are a guideline. More or less feed may be used depending upon factors such as water quality, amount of crowding, etc. Feeding should be spread over the day (see Section 3).

## APPENDIX 12

## MISCELLANEOUS ADDRESSES

**Provincial:**

Ontario Ministry of Natural Resources
Fish Culture Section
Room 2451
Whitney Block
Queen's Park
99 Wellesley St. West
Toronto, Ontario
M7A 1W3

Ontario Ministry of Industry and Trade
Small Business
7th Floor, Hearst Block
900 Bay Street
Toronto, Ontario
M7A 2E1

Ontario Ministry of Agriculture and Food
Farm Assistance Programs Branch
10th Floor, 801 Bay Street
Toronto, Ontario
M7A 2B2

Ontario Ministry of the Environment
Water Resources Branch
4th Floor, 1 St. Clair Avenue West
Toronto, Ontario
M4V 1K6

**Federal:**

Department of Fisheries and Oceans
Aquaculture and Resource Development Branch
200 Kent St., 12th Floor
Ottawa, Ontario
K1A 0E6

Federal Business Development Bank
Business Information Centre
204 Richmond St. West
Toronto, Ontario

- Source of book on federal government assistance to business in Canada.

Department of Supply and Services, Canada
Unsolicited Proposals Program
Place du Portage
Phase III
11 Laurier St.
Hull, P.Q.
K1A 0S5

## Industry Associations

Aquaculture Association of Canada
Dr. C.B. Schom, Secretary
c/o Atlantic Salmon Federation
P.O. Box 429
St. Andrews, N.B.
E0G 2X0

- membership $35 annually, includes magazine subscription.

Ontario Trout Farmers' Association
Box 1633
Guelph, Ontario
N1H 6R7

- subscription membership is $20 annually for the magazine Ontario Trout. Three to four general meetings are held annually at the University of Guelph.

## Educational Institutions

### University of Guelph:

School of Part-time Studies and Continuing Education
University of Guelph
Guelph, Ontario
N1G 2W1

Attn: N. McPherson
Tel.: (519) 824-4120 ext. 3064

- Short courses (1-2 days) on fish farming and farm ponds.

Fish Pathology Laboratory
Department of Pathology
Ontario Veterinary College
University of Guelph
Guelph, Ontario
N1G 2W1

Tel.: (519) 824-4120 ext. 2681

- Disease diagnosis and treatment.

### Sir Sandford Fleming College:

Sir Sandford Fleming College
Frost Campus
School of Natural Resources
P.O. Box 9000
Lindsay, Ontario
K9V 5E6

Tel.: (705) 324-9144

- One semester course in aquaculture as part of regular curriculum.

  May institute aquaculture as a major program within the next year or so.

## APPENDIX 13
## FISH FARMING PLANNING CHECKLIST

(Adapted from Commercial Fish Farming - How to Get Started by Walter Jones, The American Fish Farmer, 1972; and circular by the Aquaculture Program, Freshwater Institute, Canada Department of Fisheries and Oceans, 1980)

LEGAL ASPECTS:

1. Do your provincial laws and regulations permit introduction, commercial rearing and/or sale of the species of fish you are interested in?

2. What permits or licenses are required?

3. Are there other federal and provincial regulations which will affect your operations:

a) international and interprovincial regulations governing movement of fish and eggs;
b) control of predators;
c) use of algicides;
d) water rights, water access and drainage;
e) processing;
f) retailing;

ECONOMICS:

1. Develop a business prospectus detailing land or space costs, capital expenditure for fish-stock,fishstock, equipment, buildings, water impoundment construction, operating capital needed, labour requirements, costs of financing, production, harvesting and mar-keting, depreciation schedules and a profit and loss estimate. Such a prospectus is often necessary to obtain financing but, more important, it forces the prospective investor to take a hard look at the economic factors involved.

2. Do you have, or can you obtain, adequate financing for capital outlays and operating expenses through marketing the first harvest--perhaps for a period of a year or more?

3. Are you psychologically and financially prepared to only break even or perhaps to take a loss for the first year or two of operation?

4. Are you aware of all your production and/or processing costs in order to evaluate your ability to meet competition and make a profit?

a) Overhead as well as operating costs?
b) Percent of shrinkage or processing losses to expect from live harvest weight to processing plant or consumer product weight?
c) Have you figured fringe benefit costs in your labour expenses?

MANAGEMENT:

1. Personnel

a) Are you or your producion manager technically trained or have the experience to manage your operation at optimum efficiency? If not, have you arranged for management counseling and periodic checks on your operation by expert consultants?

b) Are you, or do you have available, a biologist or ichthyologist competent to make immediate diagnosis and proceed with proper chemical treatment of diseases, parasites, etc. for fishstocks and to deal with biological problems of hatching and rearing?

c) Do you have adequate skilled help to efficiently carry out all phases of your operation to maintain schedules and to meet emergencies?

2. Production Plant Facilities and Layout

a) Are your ponds, tanks, hatcheries, processing and shipping areas, etc. laid out for optimum efficiency of labour and time?

b) Are your facilities accessible during prolonged adverse weather conditions?
c) Have you accounted for expansion in your production-plant layout?
d) Are adequate utilities--three--phase electrical power, potable water, sewage disposal-available
e) What alternate production facilities should be considered - static ponds, earthen or concrete raceways?

3. Equipment

a) What apparatus and laboratory equipment will you require for testing of oxygen levels, disease and other diagnostic evaluation of your operation?
b) What emergency power unit is available in the event of failure?

4. Biological and Chemical Controls

a) What is a safe margin of oxygen level that must be maintained? Do you have provisions for emergency oxygenation of water?
b) Do you have special permits and the cooperation of provincial and federal wildlife agencies for control of predators?

MARKETING

1. Have you studied your market outlets?

a) Do you have reasonably firm market commitments as to quantity, price, price, product form?
b) Do you have alternate market outlets?
c) Can you adjust your harvest time to take advantage of high points in seasonal demand and price fluctuations, if they exist?
d) Can you provide maximum product quality, type, form and weight of products and other services your market outlet requires?
e) Do you have or can you arrange for, adequate distribution facilities and dependable supply sources to meet the time, quality and quantity demands of your market?

2. Have you planned for market promotion and education activities?

a) Scheduled an advertising budget to stimulate sales?
b) Cooperated with news media staffs to develop stories and programs to increase public awareness of the industry?

PHYSICAL FEATURES OF PRODUCTION SITE:

1. Site Location

a) Does your site possess natural elevations so that proper engineering will allow each pond to be drained independently and completely.
b) Does the land elevation permit biological supervision and general physical maintenance without excessive travel?
c) Has analysis of the soils been made to determine physical qualities for water retainment and fish culture?
d) Have core drillings been made to determine impervious qualities of subterranean soils?
e) Are your production facilities protected from crop spraying on adjacent lands?
f) Are adjacent lands subject to spraying for insects and weeds?
g) Is the site free of all possible overflow by flooding?
h) Is drainage available to natural waterways without crossing other private lands?
i) Can you economically secure your production facilities from poaching.

2. Water Supply

a) What is the source of your water supply--reservoir, well (ground) water or running streatm? Is it adequate for present and future needs? Is there an alternate source available in case of emergency?

b) Is it possible to secure the necessary water permits for the needed volume of water for your present and future needs?
c) What are the temperature variations of your water supply?
d) Has the water been tested for chemical adaptability to fish production? Have provisions been made for aerating well water? Are surface waters free from harmful chemicals?
e) Can you control predators and unwanted fish species if surface water is used?

FEEDING:

Feed Source

1. Is feed readily available in quantities needed and constant supply?

Feeding Procedure

1. What special equipment will be needed for an efficient feeding system?

2. How will you determine daily feeding rates? What factors will determine the rate of increasing feed to maintain maximum consumption and growth?

3. What feeding schedule will you follow?

4. What physical apparatus or observation procedure will you use to check feed consumption?

5. If feed consumption stops, what biological analysis must be made immediately?

6. How many areas in a given pond and over how large an area will you feed for best results?

7. When pelleted feeds are used:

a) What percentage of fines in your pelleted feed is permissible without creating water contamination?
b) What size feed pellets are best suited for fry, fingerlings and feeder fish?
c) Should you use a floating or sinking feed?

HARVESTING:

1. What is the most economical type of harvesting method for your present and future facilities?

2. How will you construct your ponds or other production facilities for the most efficient harvesting techniques?

3. Will you need special holding tanks or ponds to keep quantities of fish ready for immediate delivery?

4. Do you have sufficient and reliable manpower available for harvest period.

PROCESSING/TRANSPORT:

1. If you plan to dress and/or package fish for resale, will your facilities conform with provincial food processing and sanitation codes? Do you need processing and retail sales licenses?

2. How quickly can you take your harvest to processing area.

3. Do you have adequate chilling and/or freezing facilities to maintain high flesh quality.

4. Is it to your advantage to contract with a processor for your annual production?

5. Good service and good quality are major keys to sales expansion. Are you equipped to give both?

6. What will you use for water cooling purposes in transporting live fish--ice, refrigerated vans, refrigerated water tank?